VOLUME XXIX NUMBER FIVE

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MAY, 1916

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Sixteen Pages in Photogravure

Further Explorations in the Land of the Incas by the National Geographic Society

With 47 Illustrations HIRAM BINGHAM

Staircase Farms of the Ancients

With 32 Illustrations O. F COOK

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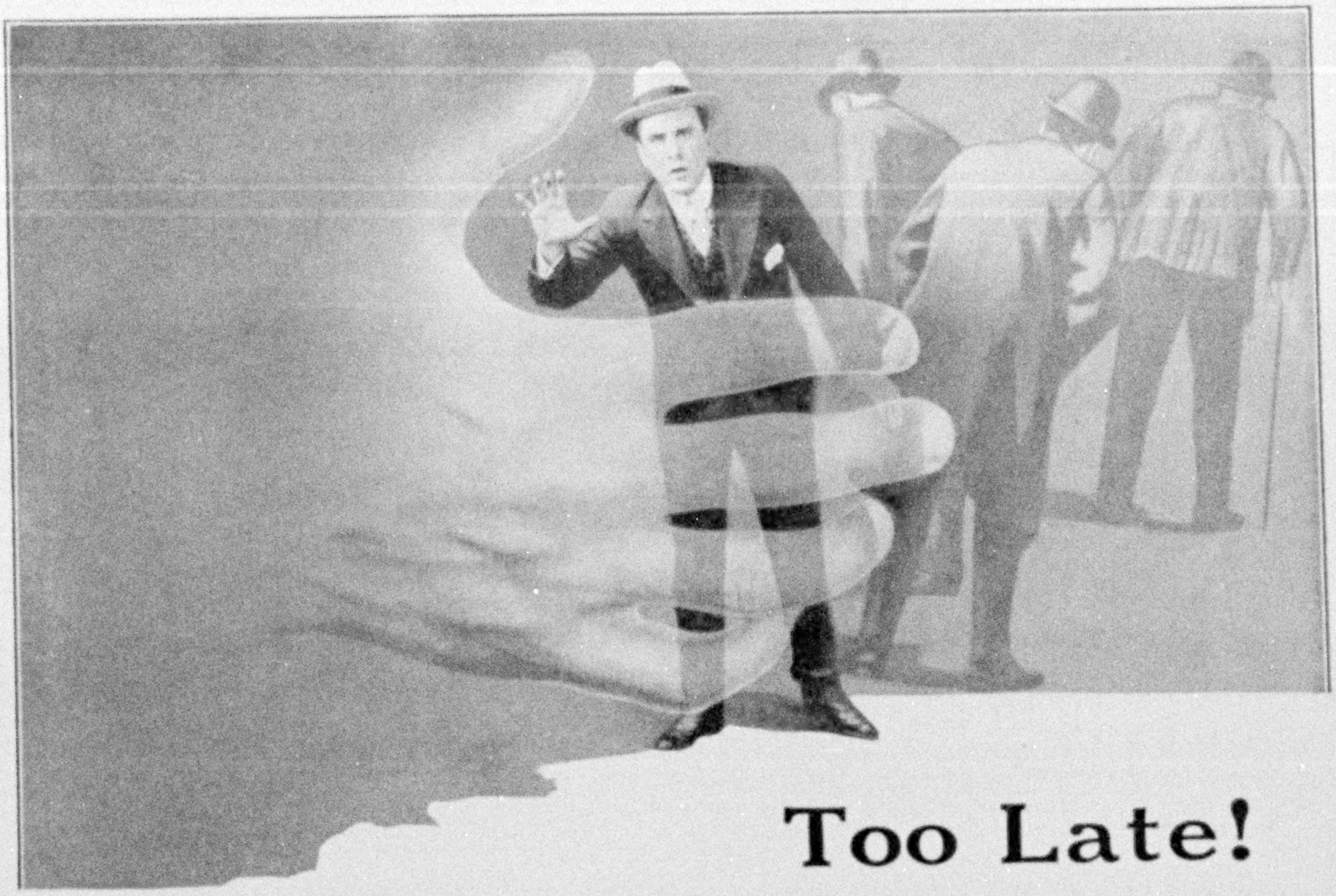

Too Late!

THE world runs on inexorable time schedule. Yet who can say what Time really is? We get it from the stars but where do the stars get it?

When you come to think of it, there's something awe-inspiring in having in your vest pocket a mechanism so delicate, so fine, so perfect, that it actually knows and measures Time—the power above the stars!

Do you own such a watch?

There are certain types of men who haven't much respect for Time. Time is nothing in the life of a tramp. Men of little character, wasters and dreamers rather pride themselves on their contempt of Time. Sooner or later, that ghostly, implacable hand reaches out and turns them back.

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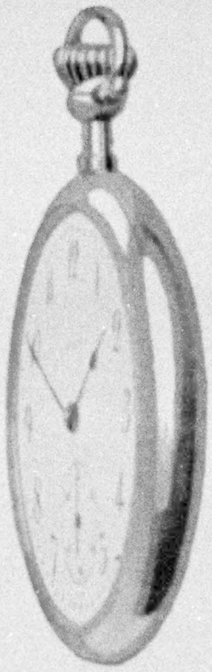

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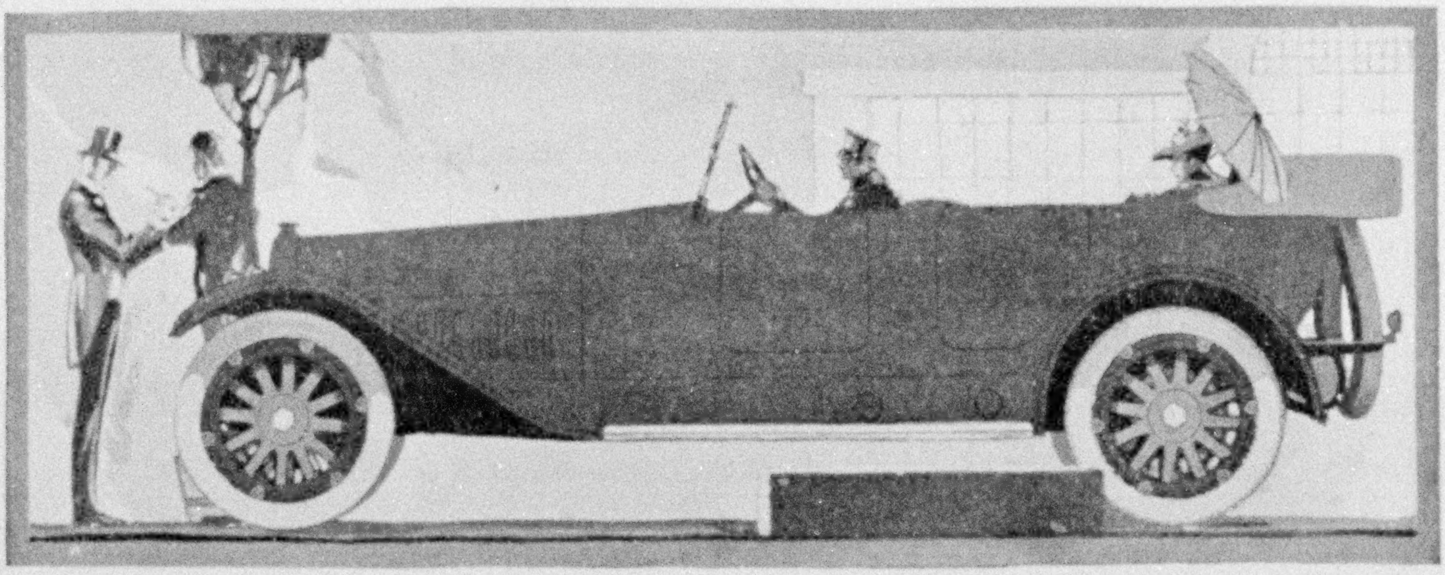

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Unique to the Mitchell—Paid for by Factory Savings

This is to tell you how factory efficiency has cut 10,000 costs on the Mitchell car.

How we build it for half what it would have cost, even in 1910.

How we build it for 20 per cent less than other factories can build it now.

And how, by those savings, we give you 26 extras which you don't find in other cars.

John W. Bate
The Efficiency Expert

In 1903—when Mitchell cars were first built—we brought John W. Bate to Racine. He was even then the greatest expert in factory efficiency in the metal-working line.

Our vehicle factory was then 70 years old. It was a model efficiency plant. And we started then to make our motor-car plant the most efficient of its kind in America.

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In the 13 years since, Mr. Bate has reduced more than 10,000 motor-car costs.

He built this whole plant—covering 45 acres—so cars could come through without the loss of a second. He equipped it with 2092 labor-saving machines—the most efficient machines that are known in this industry.

He has eliminated from the Mitchell almost every casting. In place of them he uses 184 drop forgings, which are three times as strong; also 256 steel stampings, tough and stanch.

He has invested $5,000,000 so fine cars could be built here for less than anywhere

else. No other factory which builds cars of this class can compare with it.

Not One Cent Wasted

Some motor-car makers buy all their parts. Most makers buy the larger share. But 98 per cent of this Mitchell car is built in this model plant. Thus we save under others from 20 to 40 per cent.

Part of this saving is shown in our price. No other high-grade Six of the Mitchell size sells at the Mitchell price.

The rest of the saving pays for 26 extras. We give you 26 features which others don't offer. No car in our class has more than two of them. No car at any price has more than four.

Go see these extra features. You will want every one of them. And you will not, we think, buy a car which omits them.

257 Cars in One

This new Mitchell model came out April 15—from four to eight months later than other current models.

This model was completed after the New York show. There our experts and designers examined 257 new models. And they picked out the best of the new styles in all of them—from ours and from others—in body design and equipment.

Thus the New Mitchell combines all the best things brought out at the New York show. Its lines and its luxuries—its new ideas in equipment—are the finest shown.

All this in addition to the 26 unique features which other cars don't offer.

Where Mitchell is First

In ease of riding the Mitchell car stands first. Any Mitchell dealer can prove that in five minutes. No other car in the world contains the Bate cantilever springs.

The Mitchell rides the roughest road as a boat rides waves. This comfort will astound you.

The Mitchell stands first as regards durability. Six Mitchell cars have averaged 164,372 miles each. In ordinary driving that is more than 30 years' service.

The Mitchell is the easiest car to drive. That's because of its oversize steering parts, fitted with ball bearings.

The Mitchell is long and roomy—127-inch wheelbase. It is powerful. In every way it gives greater value than any other Sixes, because of our factory economies. And it includes 26 features—all costly and important—which other cars don't offer.

Let the nearest Mitchell dealer show these extras to you. He has this new model now. If you don't know him, ask us for his name.

Six-cylinder powerful high-speed motor—127-inch wheelbase. Anti-skid tires on rear. Complete modern equipment, including motor-driven tire pump.

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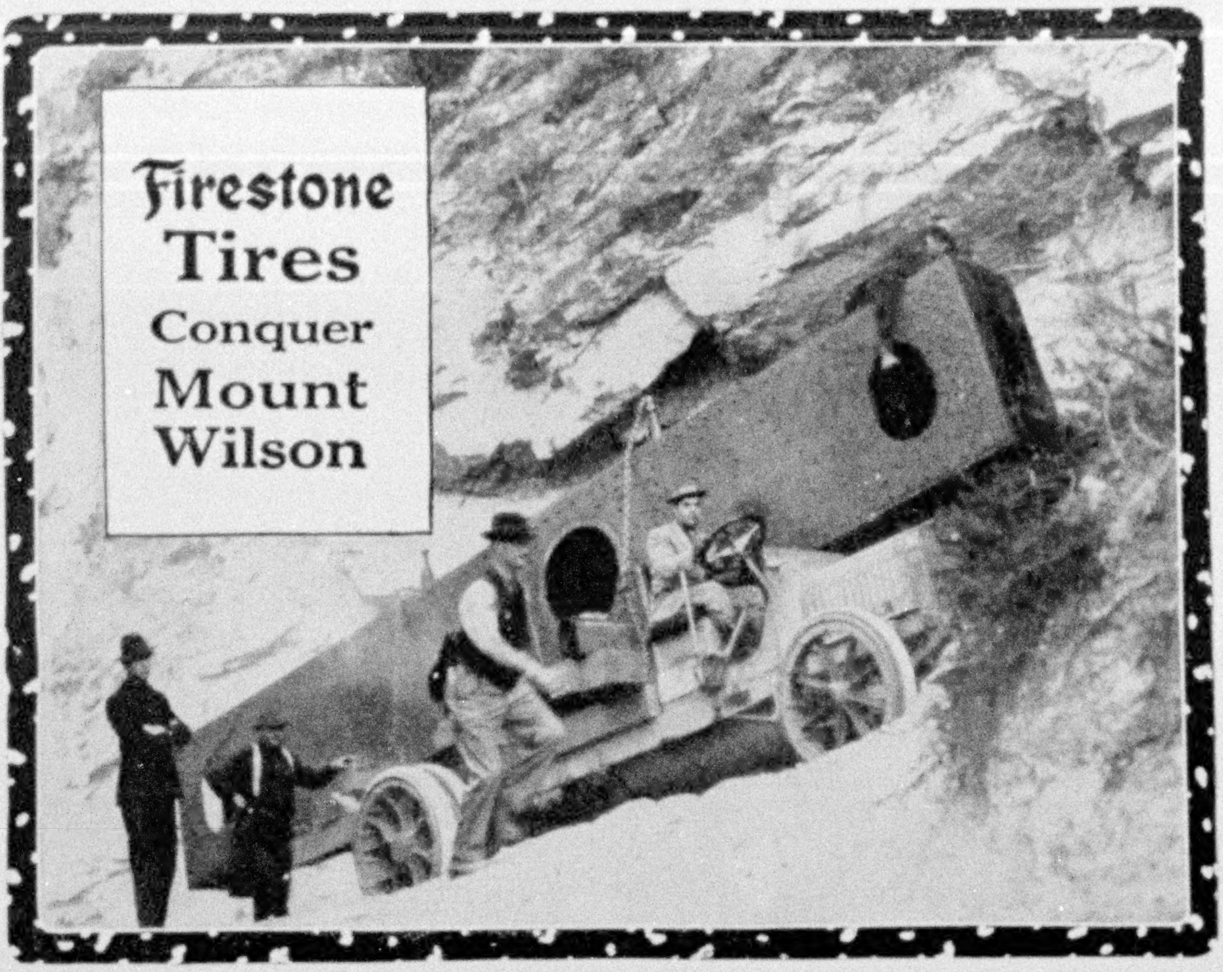

At the Top

Firestone

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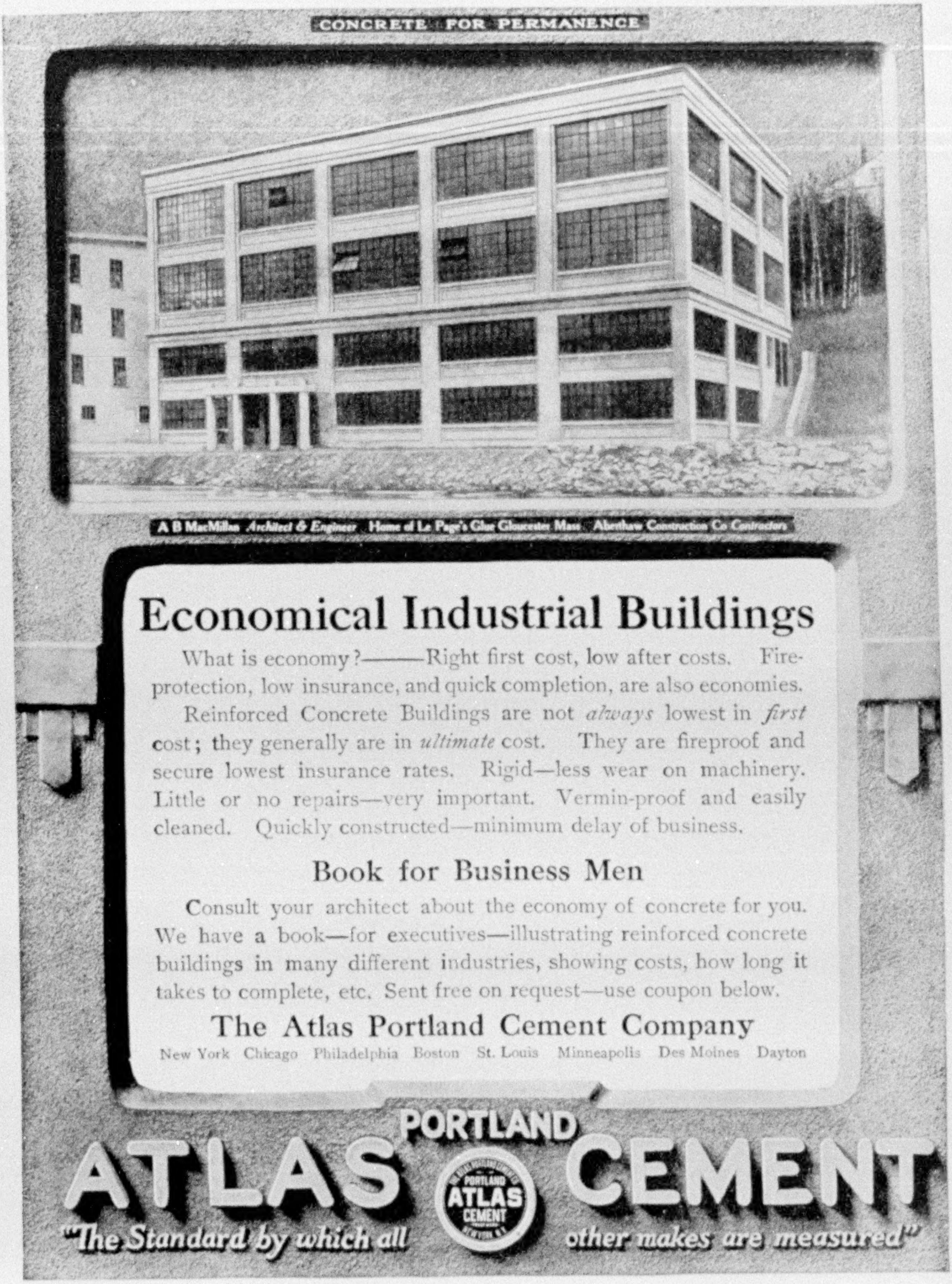

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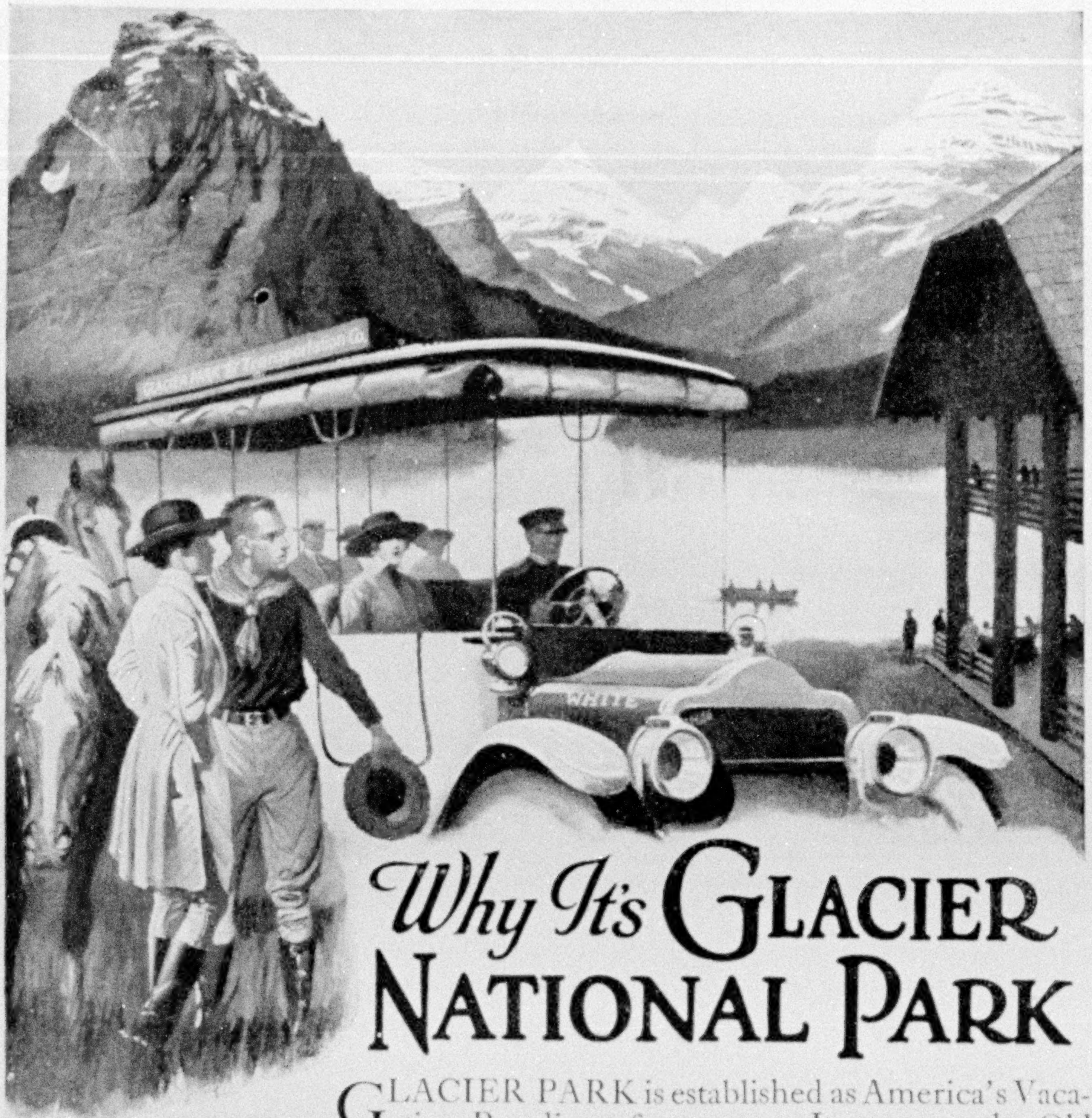

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A bonbon dish filled with these airy tit-bits. You'll find that you can't resist it.

The writer keeps Puffed Grains on his desk—Puffed Wheat, Puffed Rice, or Corn Puffs. Within an hour it's empty.

So, Mrs. Housewife, it will be with you, if you place them on your writing desk.

For these bubble-like morsels, crisp and flaky, are real food confections. They taste like nut meats puffed.

Bonbons for Breakfast

This is a plea to serve these bonbons for breakfast oftener than you do. Let them make more meals delightful.

There are three Puffed Grains, each with its own fascinations. There are many ways of serving.

They are so dainty, so flimsy, so flavory that the meals which bring them seem like festivals.

Yet they stand supreme as scientific grain foods. Prof. Anderson's process explodes every food cell. Thus every atom digests and feeds.

Puffed Grains seem like tit-bits But they are super-foods. No element in them is wasted.

Puffed Wheat 12c
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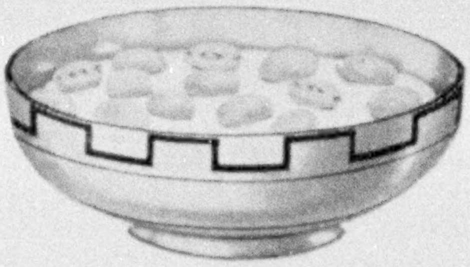
Except in Far West
Corn Puffs—Bubbles of Corn Hearts—15c



As foods, serve with cream and sugar, or in bowls of milk, or mixed with any fruit.

As confections, use in candy-making, as garnish for ice cream, or for eating dry like peanuts.

Use them as wafers in soups.

These are perfect grain foods, which look and taste like sweetmeats. And they can't be served too often.

It's too bad that more grains are not puffed.

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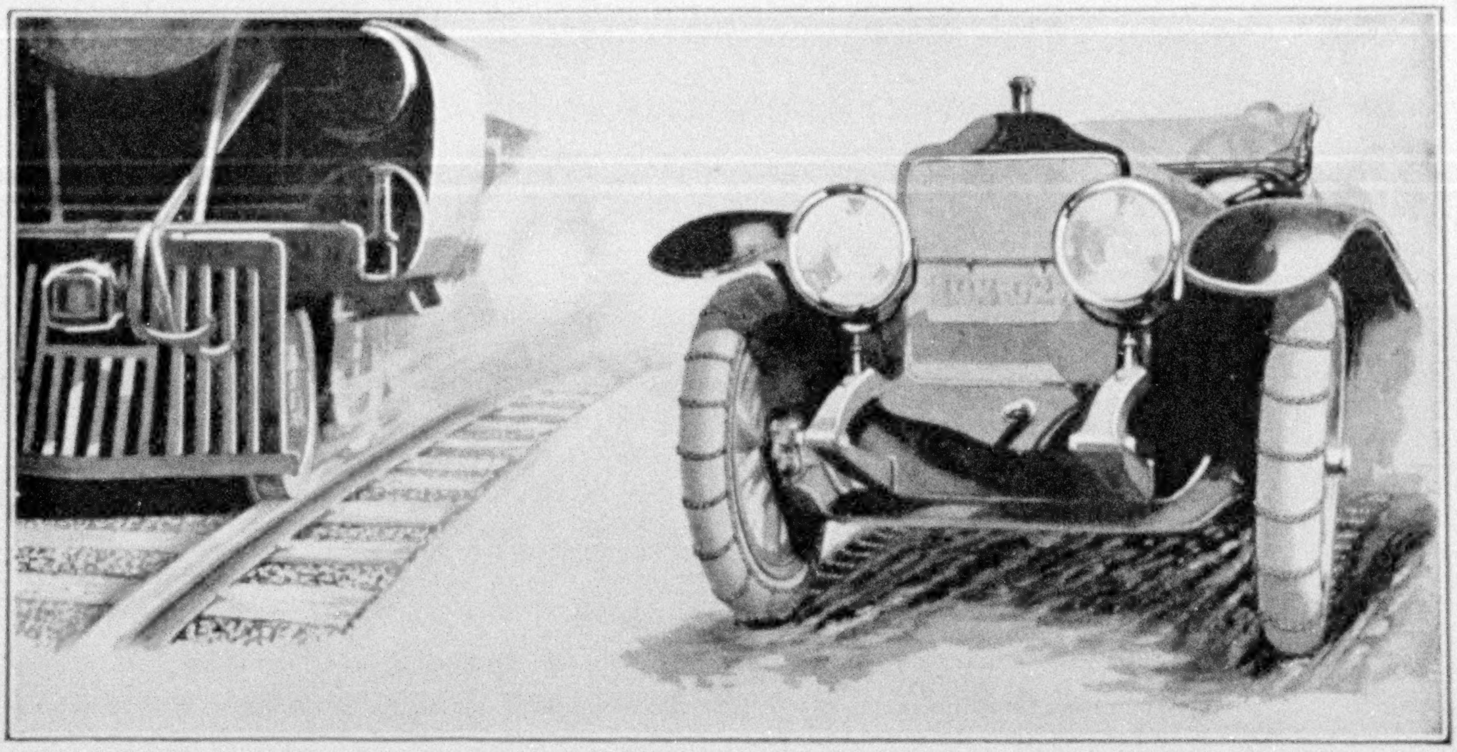
(1250)



Front Wheel Control

Weed Chains on front tires of motor cars are as necessary as flanges on front wheels of locomotives

The front wheel skid is the greatest cause of the many automobile accidents which keep the newspaper columns sprinkled with harrowing accounts. Appreciating this fact *The Scientific American* in the following editorial advocates the use of Tire Chains on the front as well as rear wheels:

> "The majority of automobile owners fit chains to the rear wheels only, and appear to consider this ample insurance against accidents from skidding, but this practice is a doubtful economy, for, although the rear wheels, thus armed, may hold the road fairly well, the really bad accidents too often result from the inability of the driver to control the course of his machine. Any old bicycle rider knows that he can retain the control of his machine and maintain his balance when the rear wheel skids badly as long as the front wheel holds its grip on the road, but that he becomes helpless whenever the front wheel slides. The same conditions are true in the case of an automobile, but in an exaggerated degree, for its weight and the average speed both tend to make the grip of the front wheels on the road precarious, and a skidding front wheel is not much different from a broken steering gear in the possibilities of disaster. Recognizing these facts, it is apparent that chains are fully as necessary on the front wheels as on the rear."

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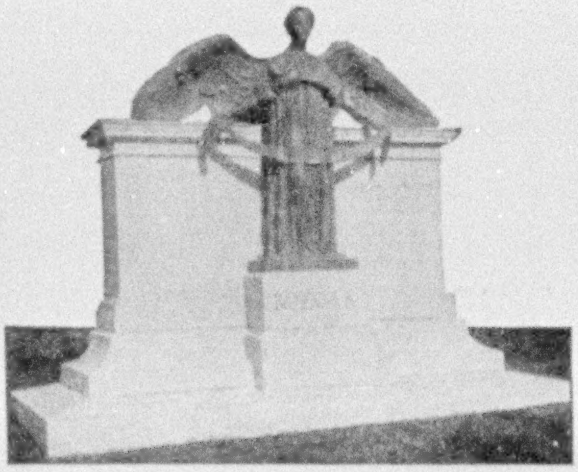

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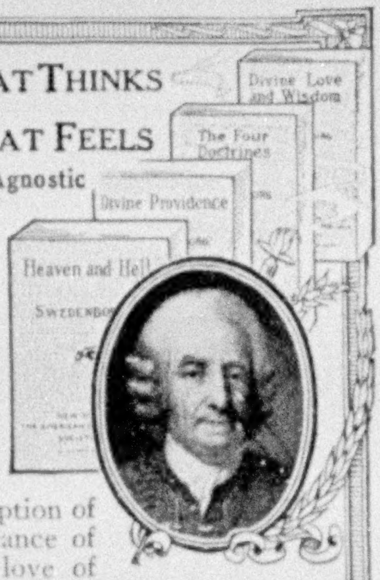

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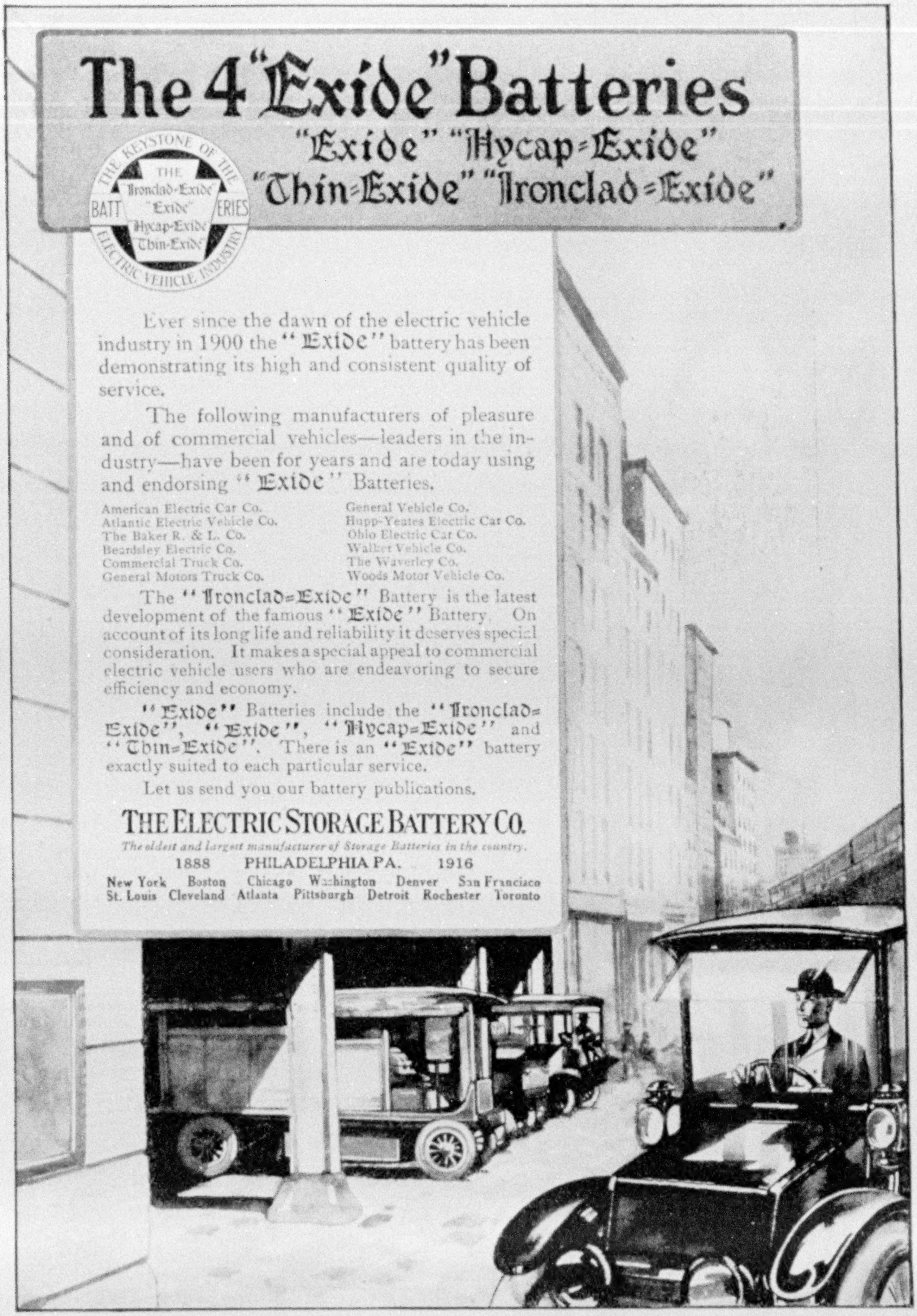

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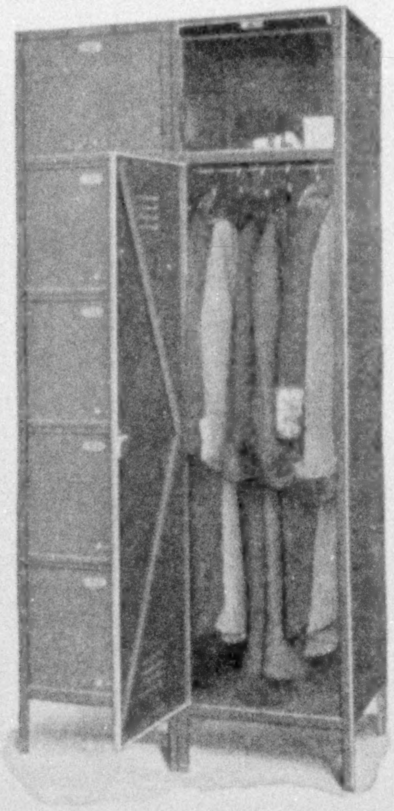

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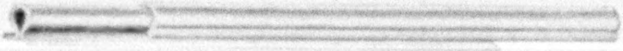

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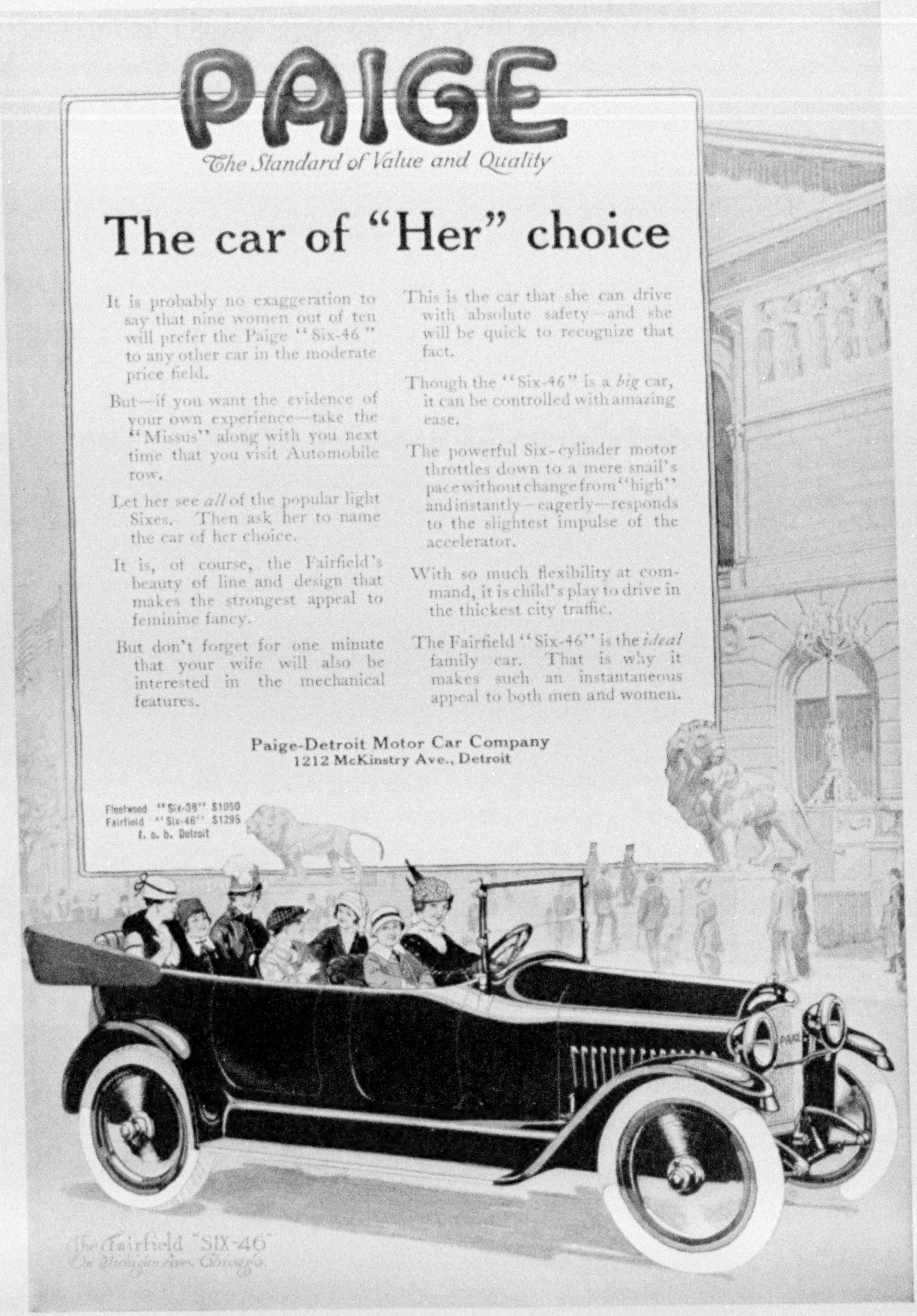

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But don't forget for one minute that your wife will also be interested in the mechanical features.

This is the car that she can drive with absolute safety—and she will be quick to recognize that fact.

Though the "Six-46" is a *big* car, it can be controlled with amazing ease.

The powerful Six-cylinder motor throttles down to a mere snail's pace without change from "high" and instantly—eagerly—responds to the slightest impulse of the accelerator.

With so much flexibility at command, it is child's play to drive in the thickest city traffic.

The Fairfield "Six-46" is the *ideal* family car. That is why it makes such an instantaneous appeal to both men and women.

Paige-Detroit Motor Car Company
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Fleetwood	"Six-38"	$1050
Fairfield	"Six-46"	$1295

f. o. b. Detroit

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BUY DIAMONDS DIRECT

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and save 20 to 40 per cent on retail or jewelers' prices

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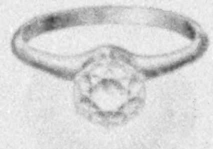
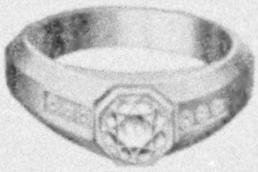


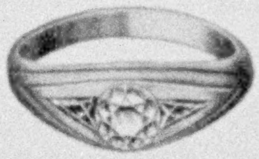
1 Carat, $95.00

This 1-carat genuine diamond is of great brilliancy and perfectly cut. Mounted in ladies' or men's style 14k. solid gold setting. Money refunded if you can duplicate it for less than $125.00. Our price, direct to you . . . **$95**



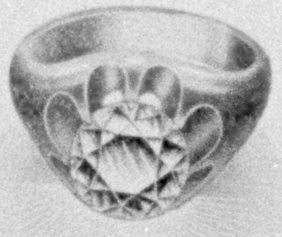
Men's Diamond Ring, $195.00

New green solid gold ring, with octagon platinum top, set with perfectly cut blue-white diamond in center. Three small diamonds on each side, also set in platinum.



Men's Diamond Ring, $165.00

New green solid gold ring, set with perfectly cut blue-white diamond and on each side is mounted a triangular cut sapphire of rich velvety blue color.



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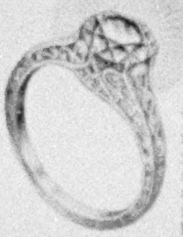
This 4-carat genuine diamond is of great brilliancy, fine color, and perfectly cut. Mounted in ladies' or men's style 14k. solid gold setting. Money refunded if your jeweler can duplicate it for less than $800.00.



Ladies' Diamond Ring, $265.00

This ring is made of all platinum, richly carved and pierced in the new lace-work effect, set with perfectly cut blue-white diamond.

Money refunded if not entirely satisfied

If desired, rings will be sent to your **Bank** or any **Express Co.** with privilege of examination. Our diamond guarantee for 5 years' full value goes with every purchase.

We refer you, as to our reliability, to any bank or newspaper in Boston.

WRITE TODAY FOR THIS BEAUTIFUL BOOK ON **HOW TO BUY DIAMONDS**

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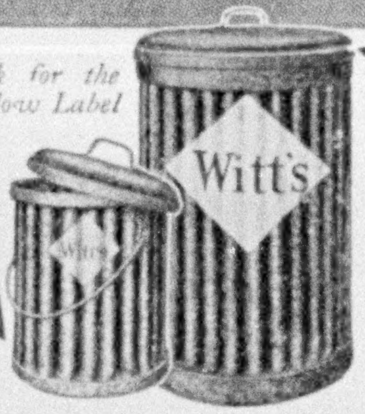
Foreign Agencies: Antwerp and Paris

This lid calls halt!

to flies, dogs, rats, roaches.

Look for the Yellow Label



Summer brings them all—exposed garbage and refuse encourage them. Witt's starves them out. Tight-fitting lid seals Witt's like a vault—living pests can't get in, dead odors can't get out. Try Witt's this time. Made of rust-proof corrugated galvanized steel. Witt's outwears several of the ordinary kind and saves you money.

Write for booklet and name of your nearest Witt dealer.

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Witt's Can and Pail

Handy Oil Can
Three in One Oil
3

Picks up Dust Like A Vacuum Cleaner

That fine, clinging dust that settles on furniture, tables, pianos, mantels, picture frames, vases—on everything about home and office—can best be removed with a Dustless Dust Cloth made dustless with

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The Universal Oil

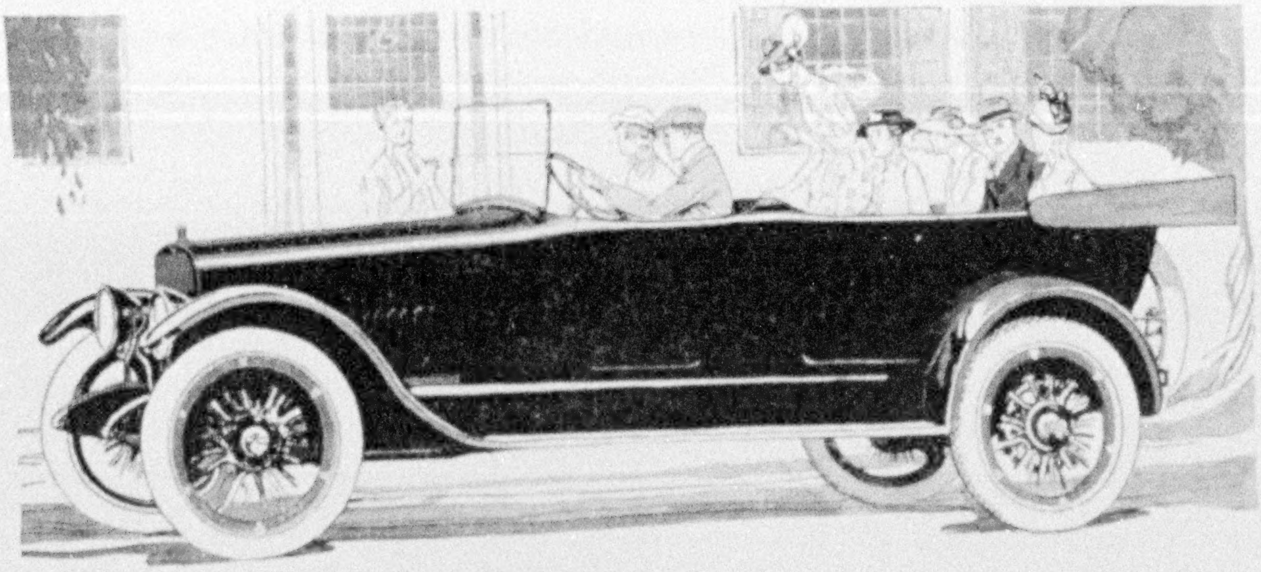
Take a piece of common cheese cloth. Sprinkle lightly with 3-in-One and put away until the oil permeates the cloth thoroughly. Then wipe the dusty surface. The dust will cling to the cloth, and shake off easily out of the window.

3-in-One is sold at all stores: In bottles, 10c, 25c, 50c. In Handy Oil Cans, 25c.

FREE—Generous sample and Dictionary of Uses.

Three-in-One Oil Co.
42UF. Broadway, New York

Three in One
3
Lubricates
Prevents Rust



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$1295

We Cannot Describe the Beauty of the New and Greater Chandler

IF YOU have seen the new Chandler touring car body you understand why we do not attempt to describe it. If you have not seen it visit the Chandler salesrooms today and get a new idea of motor car beauty.

This new touring car is the most beautiful car of the year. There can hardly be any argument as to that. Someone having reason to be biased might dispute this, but you are unprejudiced—you will look with open mind for grace of line and beauty of finish—and you will agree with what countless thousands at the automobile shows have said very positively. They have said the Chandler is the most beautiful car of the year. So go and see it.

The walnut-paneled tonneau cowl has pleased the public everywhere. It will please you. It gives the car a very unusual air of complete finish. It reflects, too, the thought which the Chandler Company gives to details throughout the car, inside and outside. And remember this, any type of touring body other than the Chandler tonneau-cowl type will be old-fashioned and out of date before the season is over. The old style design, with the backs of the front seats projecting abruptly above the body, looks odd even now.

See the Chandler. You will be delighted with the *style* of the car and you know *now* that you can *depend* on it mechanically—depend on it for all the power, speed, flexible control and day-in-and-day-out service that you could ask for in a car at any price.

For the Chandler chassis, distinguished by the Marvelous Chandler Motor, has been proven *right* through three years of service in the hands of thousands of owners. It is free from any hint of experimentation, free from any hint of untried theory.

In spite of higher prices of all materials entering into it, the Chandler is still noted for highest quality construction throughout and the finest equipment.

Seven-Passenger Touring Car - -	*$1295*
Four-Passenger Roadster - - - -	*1295*

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1405-1435 E. 131st St., Cleveland, Ohio.

New York Office, 1884 Broadway

Cable Address, "Chanmotor"

A Confidence

Based on Knowledge and Record

In 1914-15 all forms of investment were subjected to a severe test.

During this period banks increased their percentage of holdings of Public Utility Bonds.

The record of such bonds shows them entitled to increasing confidence on the part of individual investors.

The Best Income with Safety can be derived from purchasing such bonds at present prices.

Send for List AN-37.

N. W. Halsey & Co.

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Boston
Cleveland

Philadelphia
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Chicago
San Francisco
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K. N. & K.

Travelers' Checks save time and the annoyances of identification. Known and honored everywhere. **Convenient, safe, economical.**

Denominations of $10, $20, $50, and $100—at a premium of 50c. on one hundred dollars' worth.

Get them from your banker or write for full particulars.

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Equitable Building
New York City

THESE three distinguished Americans all speak in highest terms of the benefits of insurance-protection. One of them has had five years of POSTAL LIFE protection.

Let the Postal solve *your* life insurance problem

The Postal *employs no agents;* substantial savings thus effected go to *you* because you deal *direct.* You get *more* insurance for the *same* money, or the *same* insurance for *less* money.

The Company writes all the standard policy-forms and all are officially approved.

Find out what *you* can save at *your age.* Just give *full name, occupation* and *exact date of birth* and in writing. Just say: "*Send for full particulars as mentioned in The National Geographic*" for May.

POSTAL LIFE INSURANCE COMPANY
WM. R. MALONE, PRESIDENT
Thirty-Five Nassau St., New York

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Diversified 5½% July Investments

First Mortgage Serial Real Estate Bonds, issued and safeguarded under the Straus Plan, yielding 5½% net, offer you a safe investment for July funds, with opportunity for wide diversification.

You may select securities in $1,000 and $500 denominations coming due in two to ten years, each bond secured by a direct first mortgage on a high grade building and land in a different city, such as

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Thus you may avoid putting all your funds in one issue, as many conservative investors prefer to do. Since we first invest our own funds in every bond issue we offer, the safeguards which protect us in the purchase of these securities are the safeguards which protect the investors who purchase them from us.

The full meaning of our recommendation of these safe investments may be indicated by the fact that no investor has ever lost a dollar of principal or interest on any security purchased of this House, founded 34 years ago. Every July investor should

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ESTABLISHED 1882 INCORPORATED
STRAUS BUILDING 150 BROADWAY
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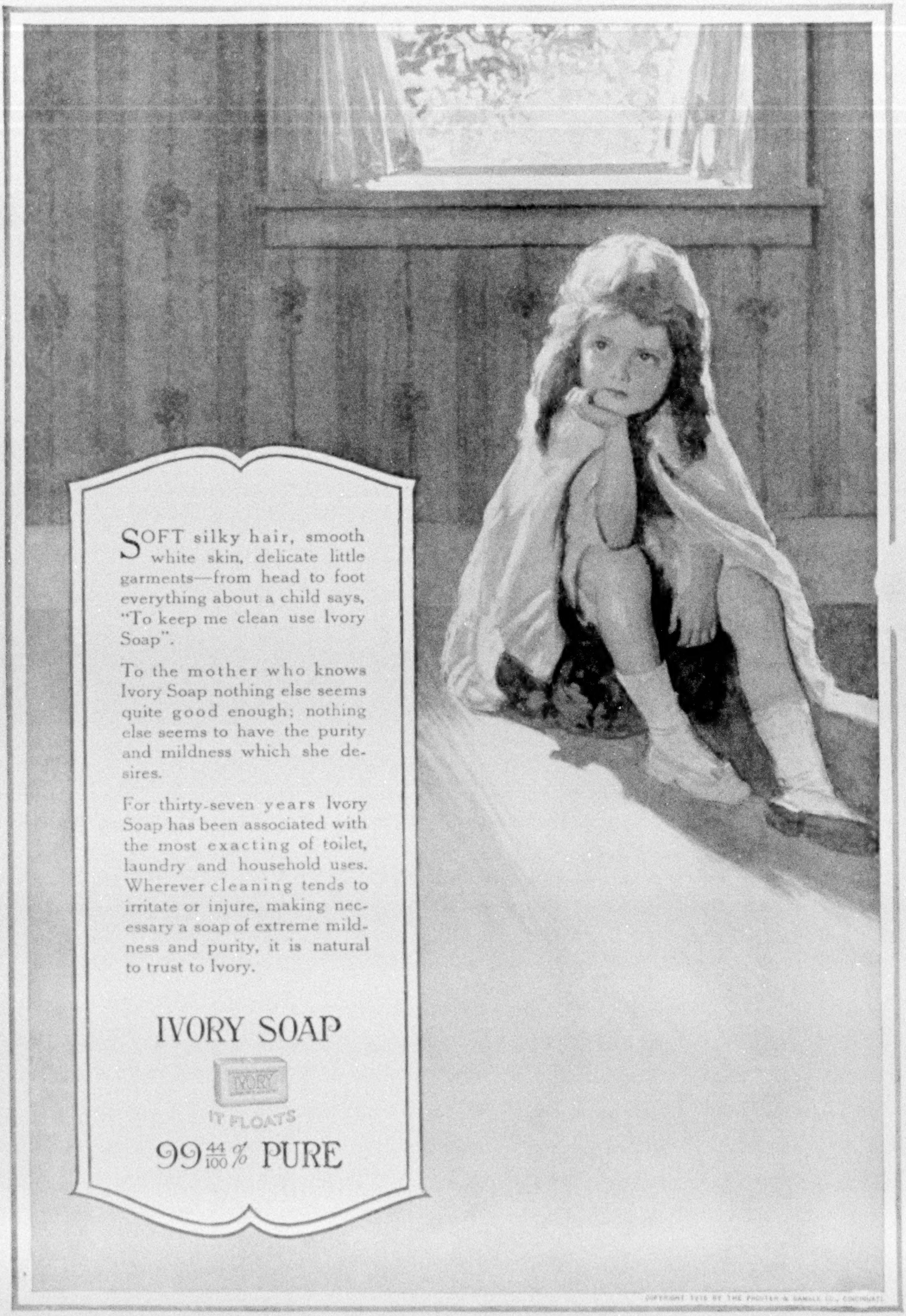

SOFT silky hair, smooth white skin, delicate little garments—from head to foot everything about a child says, "To keep me clean use Ivory Soap".

To the mother who knows Ivory Soap nothing else seems quite good enough; nothing else seems to have the purity and mildness which she desires.

For thirty-seven years Ivory Soap has been associated with the most exacting of toilet, laundry and household uses. Wherever cleaning tends to irritate or injure, making necessary a soap of extreme mildness and purity, it is natural to trust to Ivory.

IVORY SOAP

IT FLOATS

99$\frac{44}{100}$% PURE

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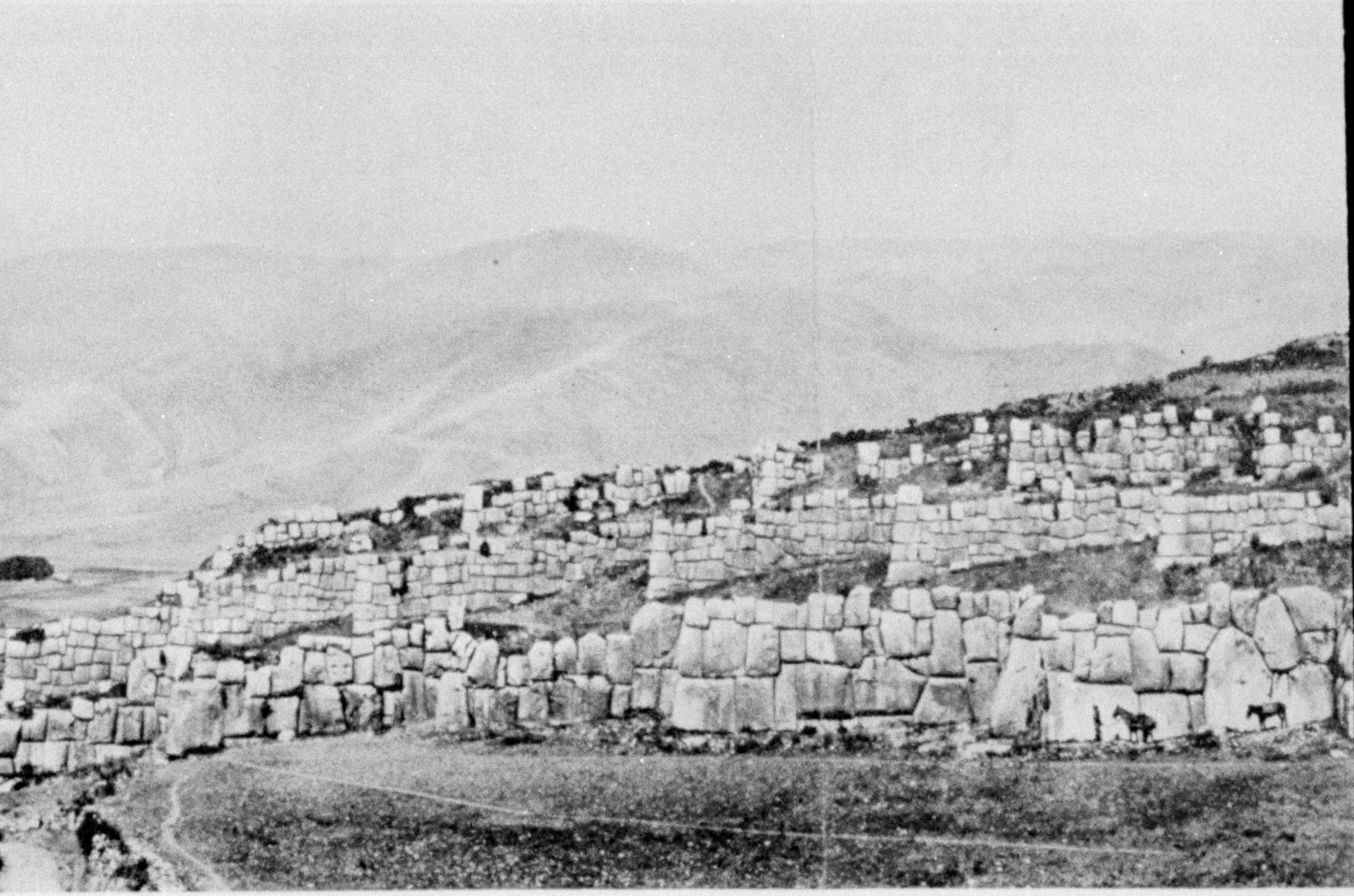
From a photograph by Hiram Bingham



THE great fortress of Sacsahuaman near Cuzco, Peru, is the most stupendous example in America of what prehistoric men could accomplish. Its builders had no better tools than stone hammers and fibre ropes, and understood no more advanced mechanical principles than the lever and the inclined plane. Many centuries ago, long before the days of the Incas, a primitive people constructed these walls. Like the inhabitants of ancient Greece, they were aware of the strategic value of salients and re-entrant angles, a knowledge which had been lost in Europe before the era of the first Crusade. The ancient builders constructed three lines of salients, extending

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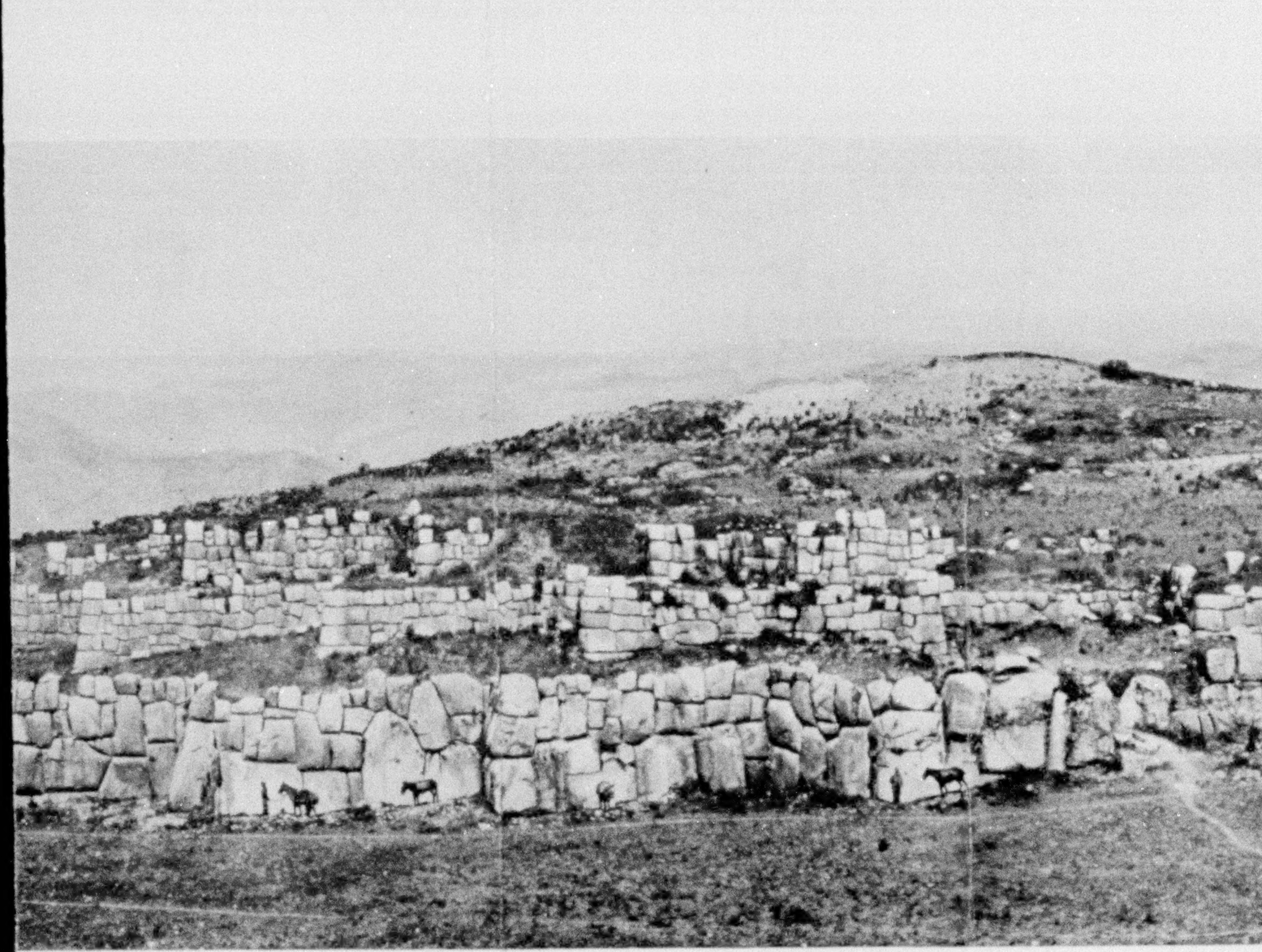

THE GREATEST ACHIEVEMENT OF ANCIENT MAN

ru, is the most stupendous example in America of what no better tools than stone hammers and fibre ropes, and than the lever and the inclined plane. Many centuries e constructed these walls. Like the inhabitants of ancient s and re-entrant angles, a knowledge which had been lost ent builders constructed three lines of salients, extending on terraces, one above another, for a third of a mile across the back of the hill whic Cuzco. The terraces are faced with colossal boulders, some of which weigh over 2 were brought from quarries in the mountains a mile or two away. Several stones in th the salient, are over 20 feet in height. An idea of the enormous size of the units of c by noticing the height of those members of the Expedition and their mules which ma of the lower wall. Notwithstanding the difficulty of handling and placing in position

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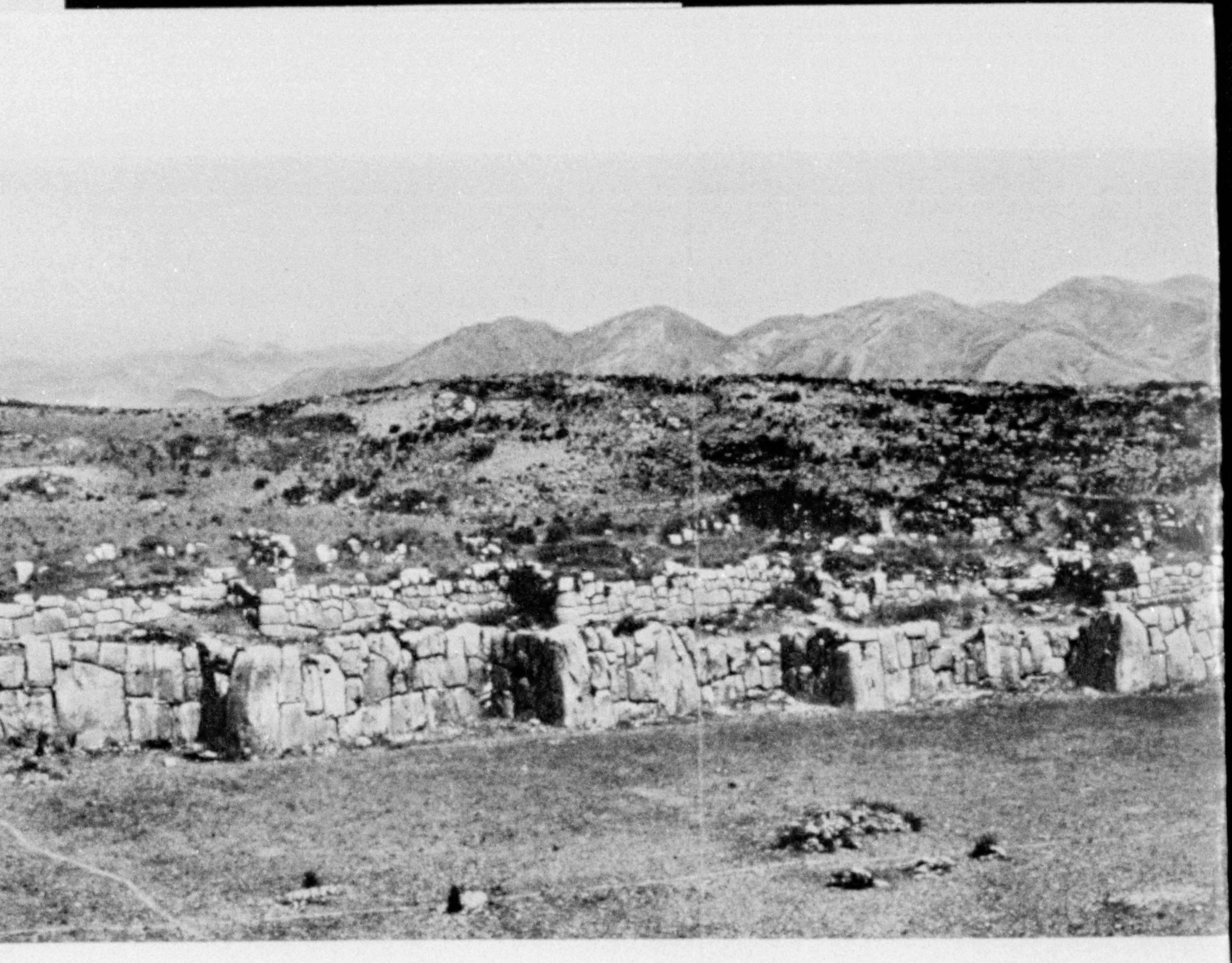

AN IN AMERICA

l which overshadows the city of
over 20 tons, and most of which
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ch may be seen standing in front
osition such enormous and extraordinarily irregular blocks, they were fitted together with great precision. No cement was used in the construction, the strength of the walls being due to the very irregularity of the blocks and the method in which they were locked together. It is almost incredible that a primitive people should have had the courage and the patience to carry out such an enormous undertaking. In the words of the Inca Garcilasso de la Vega, "It passes the power of the imagination to conceive how so many and so great stones could be so accurately fitted together as scarcely to admit the insertion of the point of a knife between them." Sacsahuaman is, indeed, one of the "Wonders of the World."

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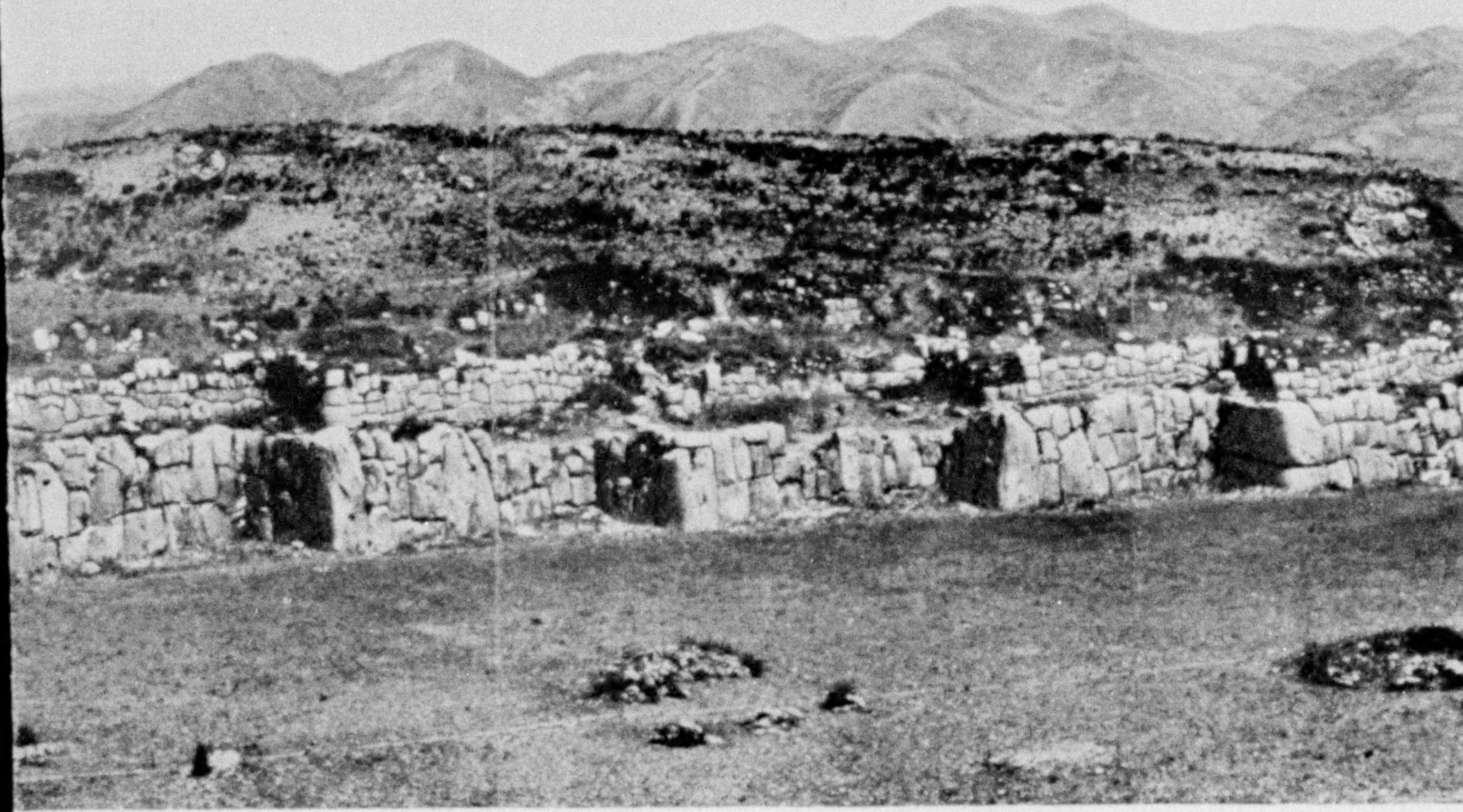
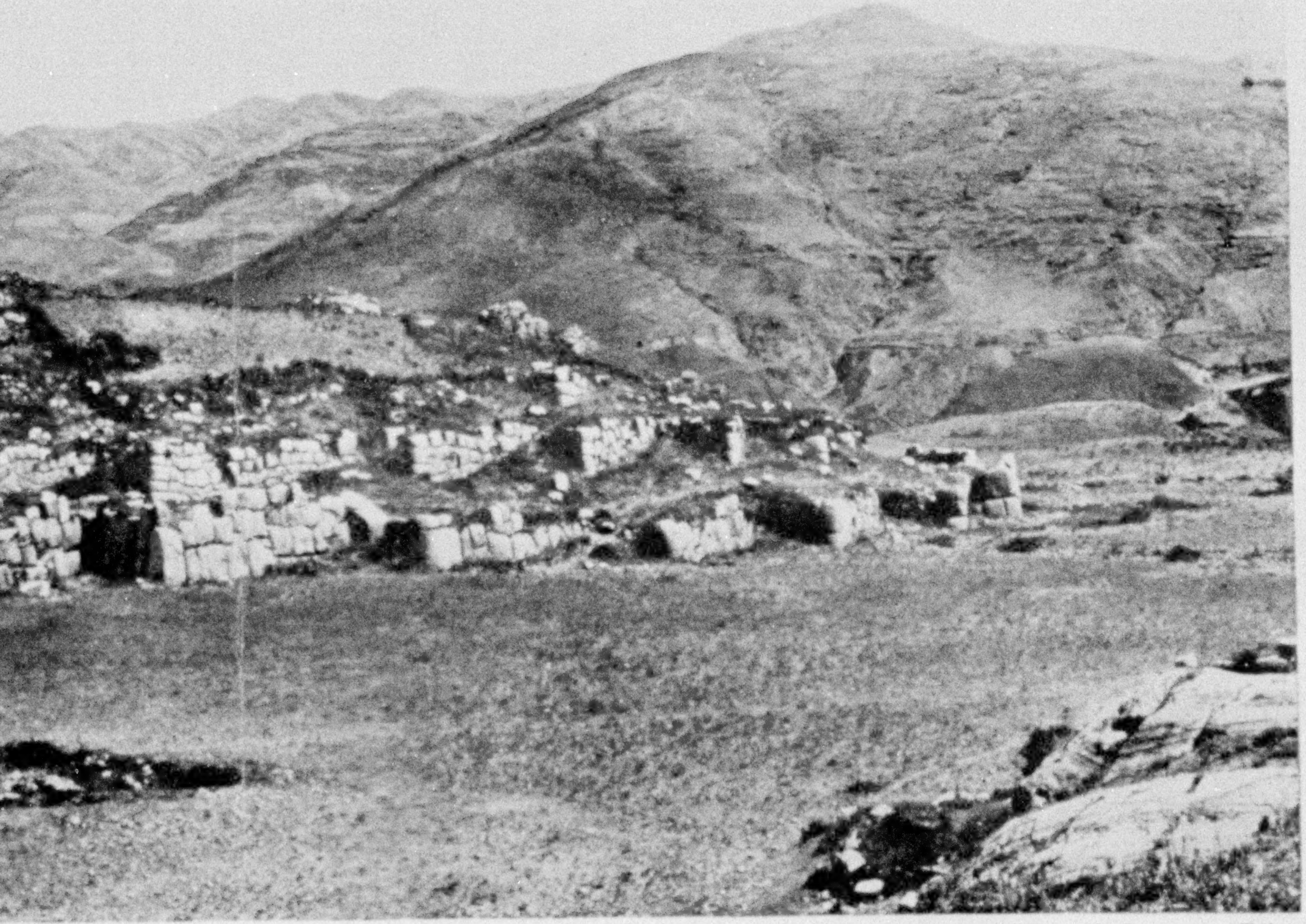


ordinarily irregular blocks, they were fitted together with great precision. No cement was used in the construction, the strength of the walls being due to the very irregularity of the blocks and the method in which they were locked together. It is almost incredible that a primitive people should have had the courage and the patience to carry out such an enormous undertaking. In the words of the Inca Garcilasso de la Vega, "It passes the power of the imagination to conceive how so many and so great stones could be so accurately fitted together as scarcely to admit the insertion of the point of a knife between them." Sacsahuaman is, indeed, one of the "Wonders of the World."



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Vol. XXIX, No. 5 WASHINGTON May, 1916

THE NATIONAL GEOGRAPHIC MAGAZINE

FURTHER EXPLORATIONS IN THE LAND OF THE INCAS

The Peruvian Expedition of 1915 of the National Geographic Society and Yale University

By Hiram Bingham, Director of Expeditions

IT WILL be remembered that it was in 1911 we commenced systematic exploration in southern Peru, in the country made famous for American readers by Prescott's celebrated classic, "The Conquest of Peru." On that expedition, which was primarily intended to search for the capital of the last Inca, Manco, who had rebelled against the Spaniards and fled into the most inaccessible part of the Andes, we discovered a considerable number of unknown ruins in a virtually unexplored region north of Cuzco. Our most important discovery was that of the wonderful city of Machu Picchu, which had been lost for so many generations that, with the exception of a few local Indians, no one in Peru was aware of its existence.

In 1912 we returned to the same country and spent several months at Machu Picchu clearing it from the forest and jungle and making such excavations as were necessary in order to restore it as far as possible to its original appearance, except that we did not attempt to put roofs on the ruins.*

In the meantime we had also discovered, through the observations of our topographers, that the surrounding country had been previously mapped with such great inaccuracy as to make the region between the rivers Apurimac and Urubamba appear to be much smaller than it was in reality. Owing to the precipitous nature of the mountains and the profound depths of the valleys and canyons (see the illustrations, pages 480-485), it was impossible for us then to penetrate the highlands immediately adjacent to Machu Picchu. We did not know whether there might not be some other place of equal or greater importance; we were unable to state how the people of Machu Picchu entered their city, or whether they had highways leading to other parts of the country.

In 1914 a considerable part of the neighboring region was mapped, some of the ruins which had been first visited in 1911 were surveyed, and, best of all, the presence of an old Inca road leading in the direction of Machu Picchu was reported.

Of their queer record stones, attractive pottery and bronzes, and of what we had been able to discover as to the history of the city by searching the ancient Spanish chronicles, members of the National Geo-

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* See "The Wonderland of Peru," with 250 illustrations, in the April, 1913, number of the National Geographic Magazine.

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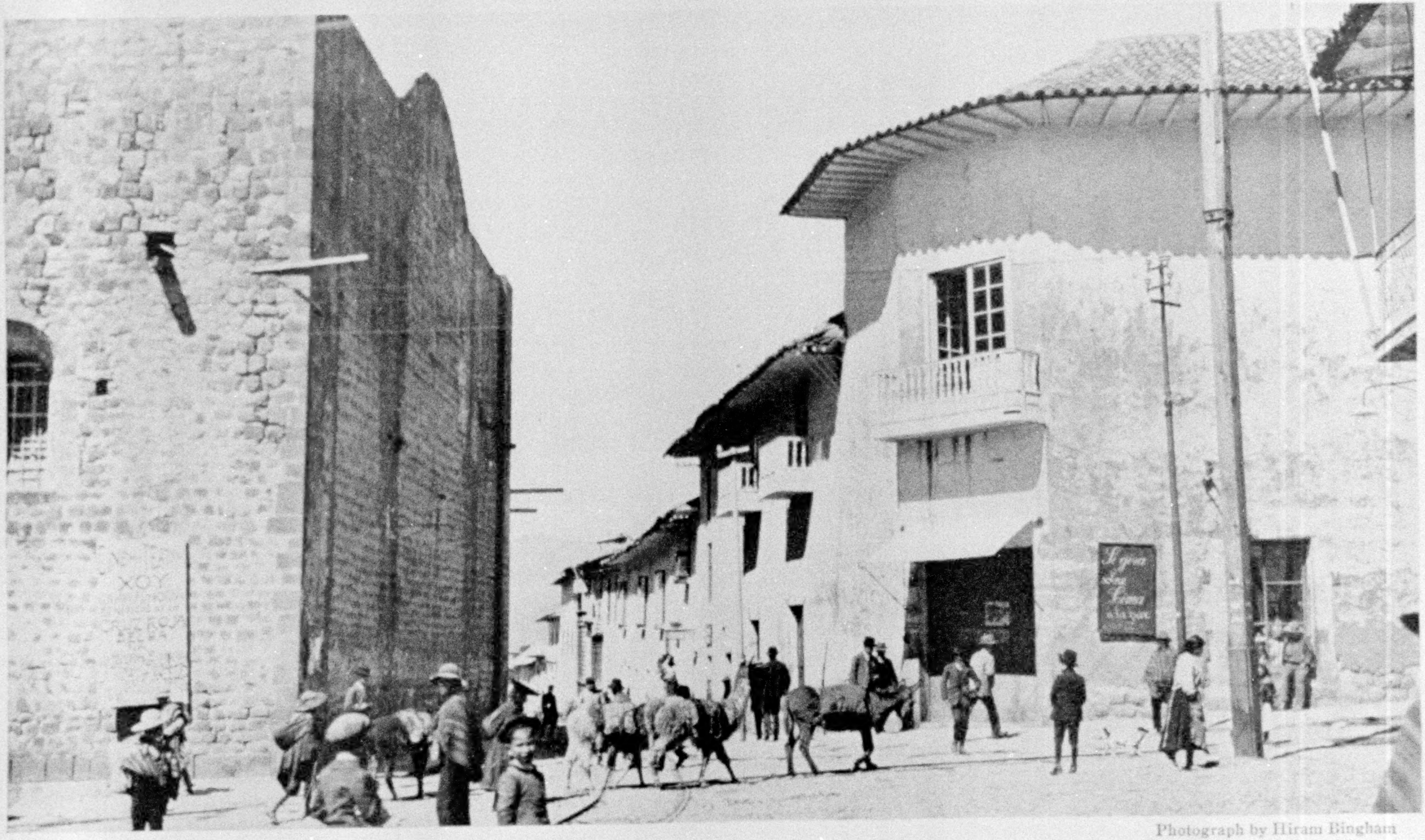
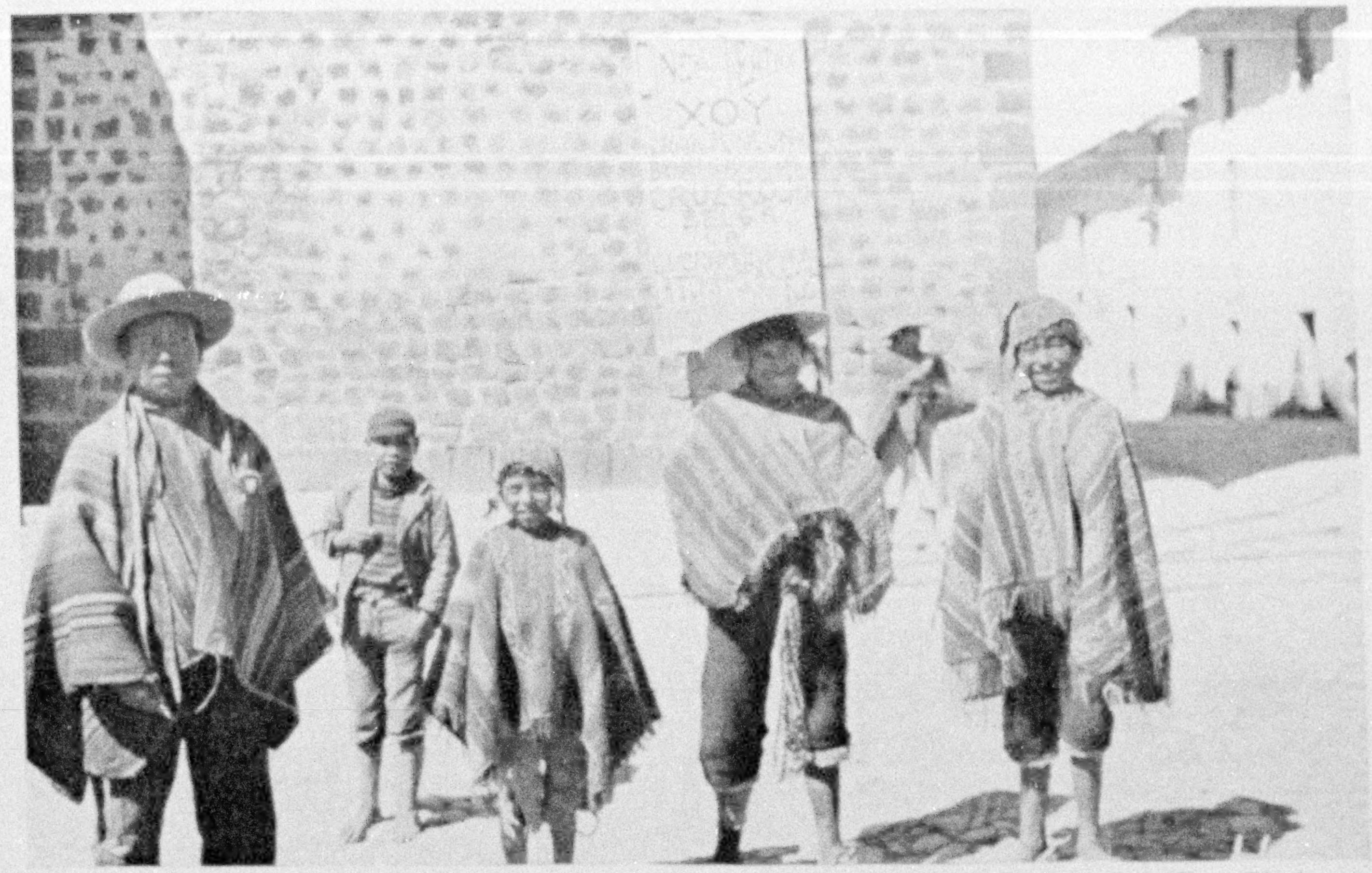


Photograph by Hiram Bingham

THE PRINCIPAL BUSINESS CORNER IN CUZCO

On the left are the walls of the convent of La Merced, built in large part of stones taken from ancient Inca structures at the time of the Spanish conquest. The advertisement thereon announces to the people even up in these remote mountain highlands the sufferings of the Belgians and bids them come to a benefit for the Belgian Red Cross at the Cuzco motion-picture theater. Prices were high and most of the people were poor, but the theater was crowded. In the middle of the picture are two llamas on their way to the market-place with produce. At the right is the establishment of Don César Lomellini, an Italian merchant, who has befriended our expedition in every way and has for several years acted as our agent in Cuzco without charge. On his wall is the advertisement that exchange on Lima may be bought at par. He is not only a banker, but sells everything from sugar mills to American candy. Further down the street, under the flagstaff, is the Cuzco post-office. The corner balcony of the Lomellini building, upstairs, opens out of Don César's private apartments. The next two balconies, on the left, open out of the wareroom which he put at the service of the expedition.



Photograph by Hiram Bingham

INDIAN BOYS, WITH VERY ELABORATE PONCHOS, VISITING CUZCO

Cuzco is the Mecca of all the Indians in southern Peru, and one of the most interesting sights in its streets are the visitors, whose district may be told by the cut of their garments and the patterns they affect. Here are shown three visitors from a distant province, who were very shy and only with the greatest difficulty could be persuaded to pose for their picture. Had it not been for the good nature of the porter, or *cargador*, who stands at the left, we could never have persuaded them to face the camera.

graphic Society were told in the February, 1915, number of this Magazine.* But of the food or the flora and fauna of those remarkable builders, who constructed splendid granite palaces and remarkable agricultural terraces in this long-hidden corner of the Andes, we were able to give very little information.

OUR PLANS FOR OUR LAST EXPEDITION

Accordingly, the Expedition of 1915 had for its chief object the securing of as much information as possible about the former inhabitants of Machu Picchu and the territory immediately surrounding the city.

Thanks to the coöperation of the Bureau of Plant Industry of the United States Department of Agriculture, we were able to investigate the original food plants of this vicinity and learn what medicinal plants were known and prized. We also secured the services of a competent naturalist to tell us with what birds and animals the people of Machu Picchu were familiar. Furthermore, we succeeded in locating several ancient roads leading toward Machu Picchu (pages 446 and 447), and while following them out discovered several new groups of ruins, evidently representing outlying fortresses and fortified stations used for the defense of the capital and for the convenience of travelers on the highways. Finally, by process of elimination, we were able to prove that Machu Picchu was the capital of a considerable area of country that was once densely populated.

In the course of our work we crossed a number of hitherto-unexplored areas, collected large numbers of botanical and zoölogical specimens, mapped a new river system, and took measurements of nearly all of the savage inhabitants of the newly visited valley, besides many of the semi-civilized folk of the older valleys.

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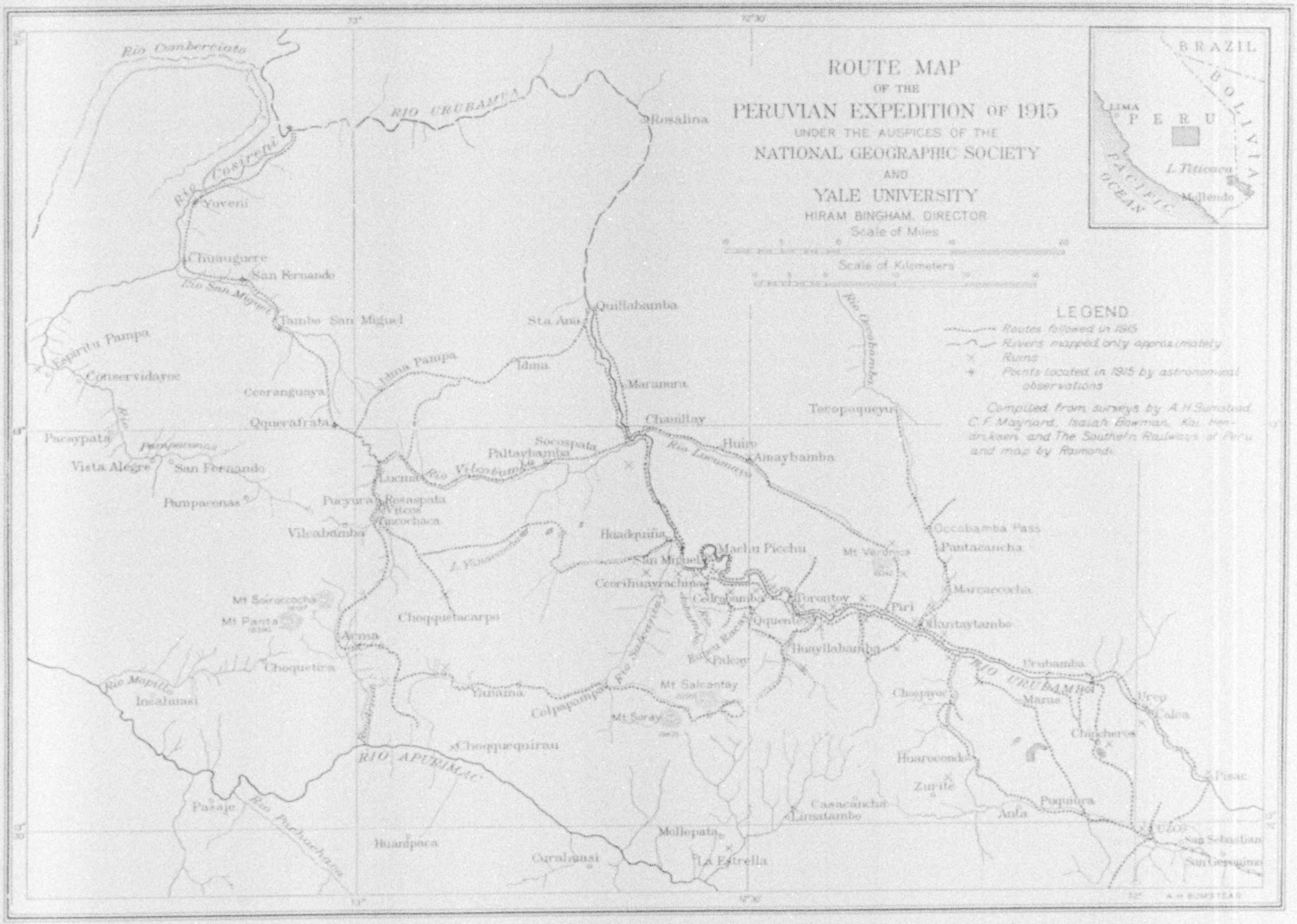
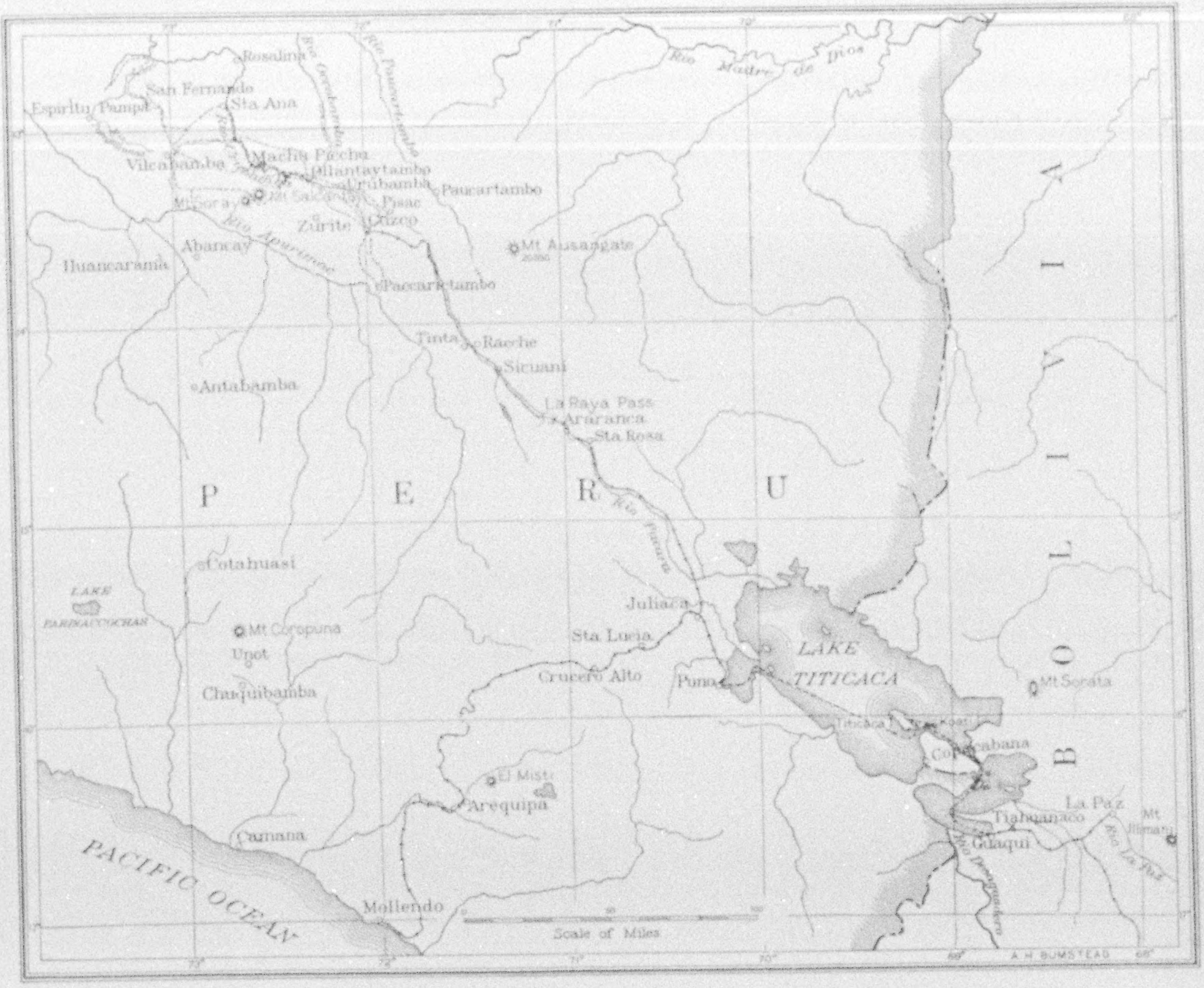
* See "The Story of Machu Picchu," with 60 illustrations, in the NATIONAL GEOGRAPHIC MAGAZINE, February, 1915.


ROUTE MAP
OF THE
PERUVIAN EXPEDITION OF 1915
UNDER THE AUSPICES OF THE
NATIONAL GEOGRAPHIC SOCIETY
AND
YALE UNIVERSITY
HIRAM BINGHAM, DIRECTOR
Scale of Miles
Scale of Kilometers
LEGEND
Routes followed in 1915
Rivers mapped only approximately
Ruins
Points located in 1915 by astronomical observations
Compiled from surveys by A.H. Bumstead, C.F. Maynard, Isaiah Bowman, Kai Hendriksen and The Southern Railways of Peru and map by Raimondi
BRAZIL
BOLIVIA
PERU
LIMA
L. Titicaca
Mollendo
PACIFIC OCEAN
Rio Comberciato
RIO URUBAMBA
Rosalina
Rio Cosireni
Yuveni
Chuauguerre
San Fernando
Rio San Miguel
Tambo San Miguel
Espiritu Pampa
Conservidayoc
Ccoranguaya
Idma Pampa
Idma
Sta Ana
Quillabamba
Maranura
Chaullay
Querafrata
Pacaypata
Rio
Vista Alegre
San Fernando
Pampaconas
Pampaconas
Socospata
Paltaybamba
Rio Vilcabamba
Lucma
Pucyura
Rosaspata
Vitcos
Tincochaca
Vilcabamba
Rio Lucumayo
Huiro
Amaybamba
Teropoqueyu
Rio Occobamba
Occobamba Pass
Pantacancha
Mt Verónica
Marcacocha
Huadquiña
Machu Picchu
San Miguel
Ccorihuayrachina
Corbamba
Torontoy
Piri
Ollantaytambo
Quente
Huayllabamba
Pulpa Rasa
Palcay
Mt Salcantay
Mt Soray
Colpapampa
Rio Salcantay
Yanama
Choqquetacarpo
Mt Soiroccocha
Mt Panta
Arma
Choquetira
Rio Mapillo
Incahuasi
Choqquequirau
RIO APURIMAC
Pasaje
Rio Pachachaca
Huampaca
Curahuasi
Mollepata
La Estrella
Limatambo
Casacancha
Zurite
Huarocondo
Chaquaytambo
Anta
Puquiura
Urubamba
RIO URUBAMBA
Maras
Chincheros
Yucay
Calca
Pisac
Cuzco
San Sebastian
San Geronimo
73°
72°30'
72°
13°
13°30'
A. H. BUMSTEAD

ROUTE MAP SHOWING TERRITORY EXPLORED IN 1915

This map, which is a larger scale representation of the territory in the extreme northwestern portion of the one on the opposite page, shows by dotted lines the routes followed by the Expedition of 1915 in its work of exploring and mapping that section of the highlands of Peru which has Machu Picchu for its center. By locating Cuzco, in the southeastern corner of this map and in the northwestern corner of the other one, the reader can connect them without difficulty.


Rosalina
San Fernando
Espiritu Pampa
Sta Ana
Vilcabamba
Machu Picchu
Ollantaytambo
Urubamba
Paucartambo
Pisac
Cuzco
Zurite
Abancay
Rio Apurimac
Huancarama
Mt Ausangate
Paccaritambo
Tinta
Racche
Sicuani
Antabamba
La Raya Pass
Ararança
Sta Rosa
P E R U
Rio Pucara
Cotahuasi
LAKE PARINACOCHAS
Mt Coropuna
Unot
Chuquibamba
Juliaca
Sta Lucia
Crucero Alto
Puno
LAKE TITICACA
Mt Sorata
Copacabana
B O L I V I A
El Misti
Arequipa
Camana
PACIFIC OCEAN
Mollendo
Scale of Miles
La Paz
Mt Illimani
Tiahuanaco
Guaqui
Rio La Paz
Rio Desaguadero
Rio Madre de Dios
Rio Paucartambo
A. H. BUMSTEAD

SKETCH MAP OF SOUTHERN PERU

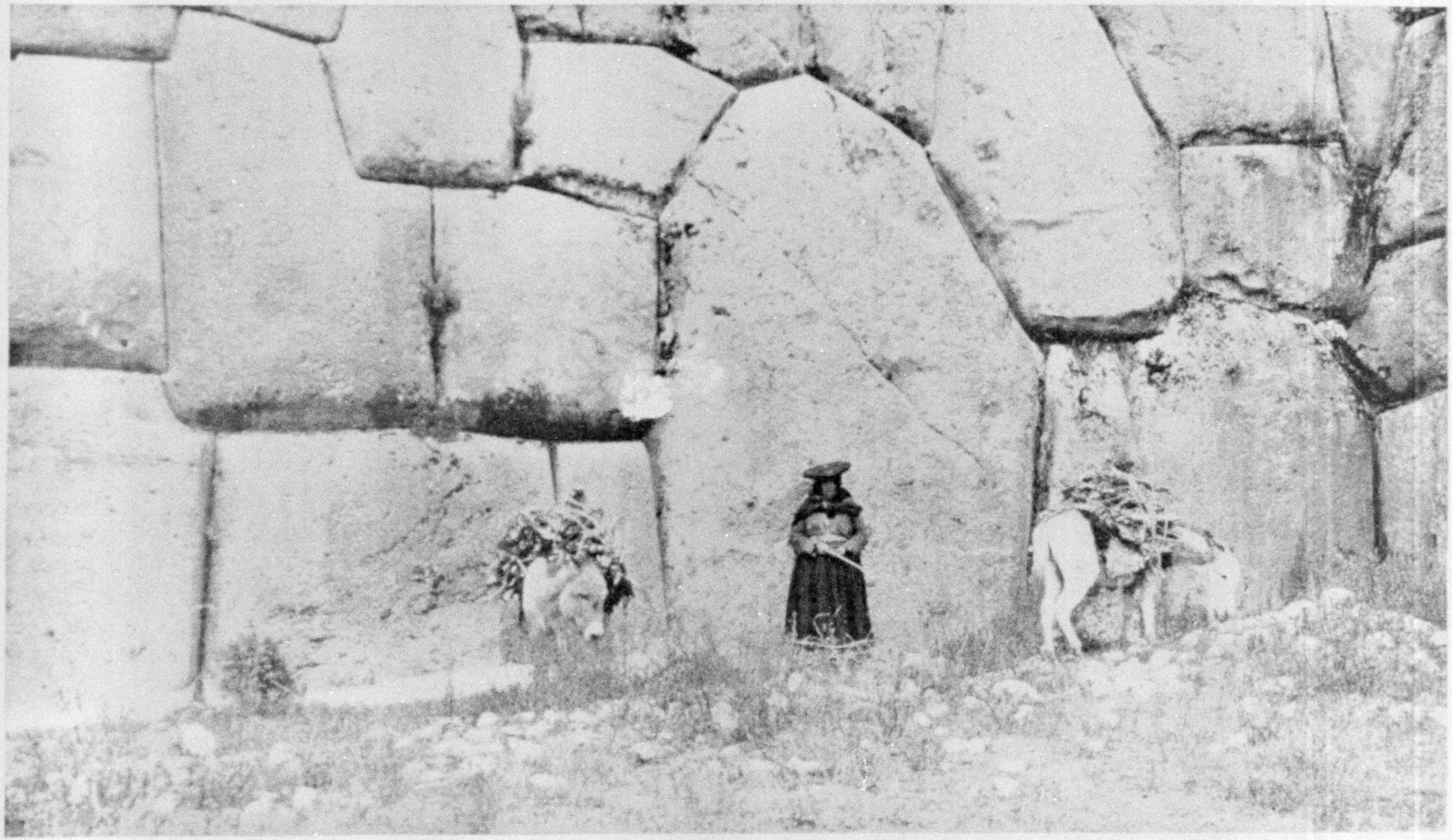
This map shows that part of Peru in which the National Geographic Society-Yale University Expeditions were particularly interested. The work of the 1915 Expedition was limited to that narrow stretch of territory shown in the extreme northwestern portion of the map west of Cuzco and north of Abancay, and represented in greater detail in the map on the opposite page.

ADVANTAGES OF HAVING A MANY-SIDED STAFF

Since we have now concluded our studies in the region about Machu Picchu, it may be of interest to the members of the National Geographic Society, who have so generously supported these expeditions, to learn something of our methods of work. In explorations in foreign lands a certain amount of time must be wasted. There is tedious work to be done in establishing friendly relations with the foreign government, securing the requisite permits and introductions, forming satisfactory connections with reliable local business houses, purchasing the necessary equipment and supplies, securing efficient and trustworthy native assistants, etc.

The amount of bother and trouble is not materially increased by having a reasonably large expedition, so we have always deemed it decidedly worth while from the point of view of economy to have as many branches of science as possible represented in our party.

There are other obvious advantages to be gained by having men of distinctly different tastes and training working together in a new territory. While each man cannot cover the entire country, his opportunity is broadened by the possibility of one of the other members of the party being able to report to him the



Photograph by Hiram Bingham

PART OF THE LOWER LINE OF FORTIFICATIONS IN THE FORTRESS OF SACSAHUAMAN, NEAR CUZCO

The gigantic size of these huge stones and the extraordinary care and precision with which they are fitted together without mortar or cement by the ancient megalithic builders make this great fortress the most striking monument in the New World to the remarkable perseverance and engineering skill of the American aborigines. This picture shows a small part of the fortress illustrated in the marvelous panorama printed as a frontispiece to this number of THE GEOGRAPHIC.

presence of new material that he would otherwise have missed seeing.

For instance, on this last expedition the most interesting fossil—a portion of the shell of a gigantic antediluvian "land turtle"—was found by one of our civil engineers in the office of a village magistrate whom he was visiting for reasons of diplomacy. The head and skin of a fine puma or mountain lion, the largest and perhaps one of the rarest mammals in Peru, was secured not by the naturalist, but by the surgeon while on a journey to see a very sick priest some 40 miles from our headquarters. Had it not been for the surgeon's willingness to go far out of his way in attending to this call of charity, our collections would not include a puma. It happened that a belt of forest, probably the highest known in the world, was located by the director while on a reconnaissance trip through a region which the botanist was unable to reach. On the other hand, the botanist was the first to observe an interesting feature in the fortress near Cuzco, namely, a groove cut across a cornerstone so as to add to its symmetry by making it appear to be two stones instead of one. The naturalist spent several weeks in an unsuccessful attempt to locate the presence of a spectacled bear, until one was accidentally found by the director while engaged in archæological reconnaissance along one of the old trails leading to Machu Picchu.

Thus it will be seen that a single party, devoted to the study of one subject, is at a disadvantage even in its own specialty, as compared with an expedition composed of several parties of observers trained in various fields of investigation.

The Expedition of 1915 included the following: Hiram Bingham, Ph. D., *Director;* O. F. Cook, of the Bureau of Plant Industry, U. S. Dept. of Agriculture, *Botanist;* Edmund Heller, B. A., *Naturalist;* Clarence F. Maynard, C. E., *Topographer;* David E. Ford, M. D., *Surgeon;* Osgood Hardy, M. A., *Interpreter* and *Chief Assistant;* Elwood C. Erdis, *Chief Engineer;* J. J. Hasbrouck, Ph. B., *Engineer;* Geoffrey W. Morkill, *Assistant in Charge of Headquarters;* G. Bruce Gilbert, of the Bureau of Plant Industry, U. S. Dept. of Agriculture, *Assistant Botanist;* Ricardo Charaja, *Assistant to the Director.*

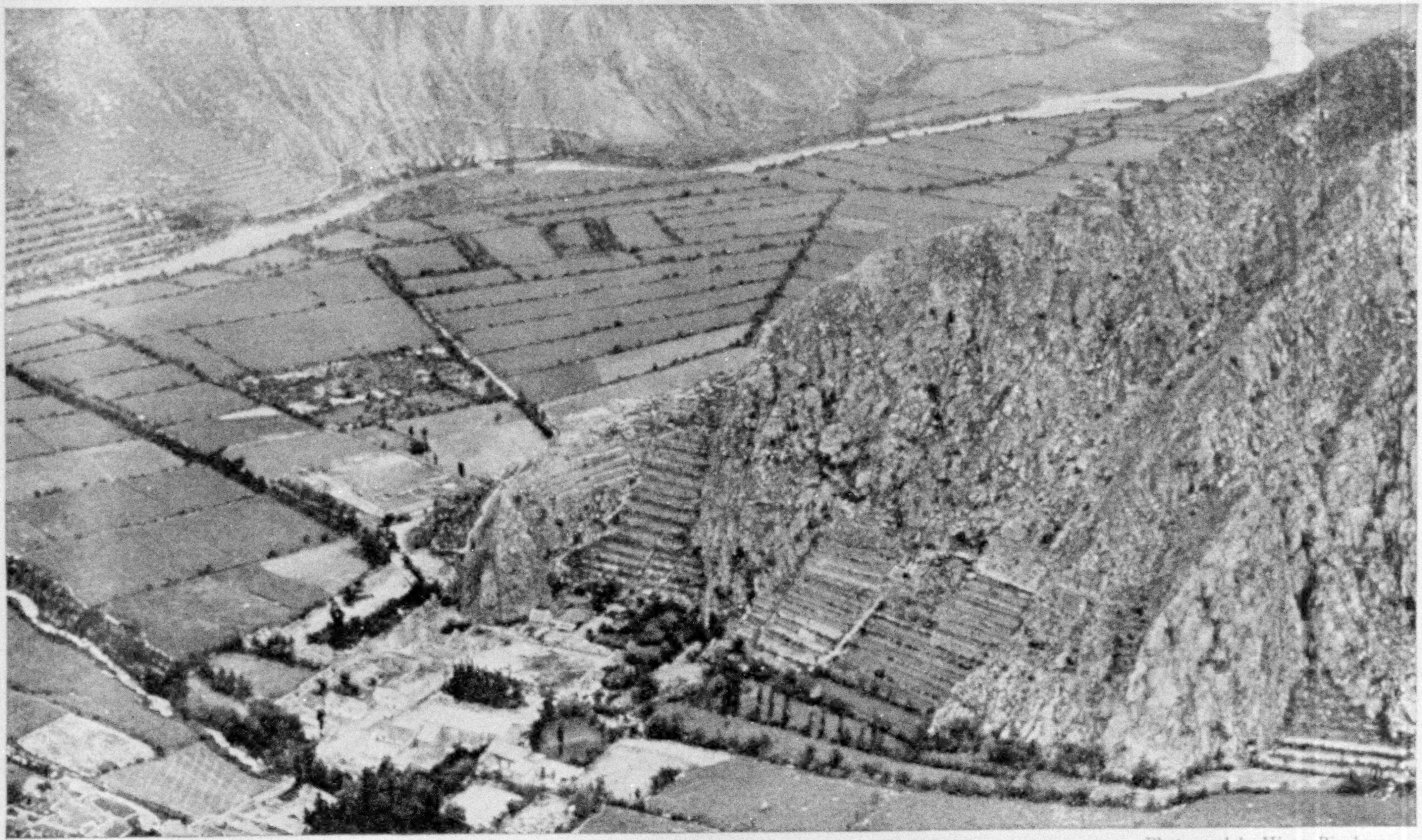
In addition, we had such native guides, muleteers, and soldiers as were necessary. We used 50 mules and 5 horses.

On the 1911 Expedition Prof. H. W. Foote, of the Sheffield Scientific School of Yale University, had coöperated with me in assembling a balanced ration in "unit food boxes." The object of this plan was to facilitate the provisioning of our parties by packing in a single box everything that two men would need in the way of provisions for a period of one or two weeks, depending on the size of the case. We found that the larger box was too heavy, so in 1915 only the smaller size was used. These boxes have given such general satisfaction, not only to the men themselves, but to the surgeons who had the responsibility of keeping us in good condition, that a few words in regard to this feature of our equipment may not be unwelcome at this point.

THE NECESSITY OF VARIED AND WHOLESOME FOOD

Many people seem to think that it is one of the duties of an explorer to "rough it" and "trust to luck" for his food. I had found on earlier expeditions that the result of being obliged to subsist on irregular and haphazard rations was most unsatisfactory. While "roughing it" is far more enticing to the inexperienced explorer than the humdrum expedient of carefully preparing, months in advance, a daily bill of fare that shall be sufficiently varied, wholesome, and well balanced, the results of such "trusting to luck" are very unsatisfactory.

The truth is that providing an abundance of well-selected and properly cooked food adds very greatly to the efficiency of a party. It means far more trouble and expense for the transportation department, and some of the younger men on our parties sometimes feel that their reputation as explorers is likely to be damaged if it is known that strawberry jam, sweet chocolate, cheese, and pickles are frequently found on their bills of fare! But experience has shown that



Photograph by Hiram Bingham

A BIRD'S-EYE VIEW OF OLLANTAYTAMBO

Here the Peruvian Expedition of 1915 made its headquarters, in a rejuvenated Spanish building, seen in the center foreground at the right of the long church. The ruins in and about Ollantaytambo are among the most interesting in South America, and consist not only of fairly recent Inca structures, less than 400 years old, but of megalithic remains of unknown antiquity. The end of the promontory was strongly fortified and almost impregnable. The banks of the Urubamba River in the distance are terraced. The Urubamba Valley at this point is still intensely cultivated on remarkable great terraces that were laid out by the Incas and their predecessors many centuries ago (see "Staircase Farms of the Ancients," by O. F. Cook, in this number).

the results of "trusting to luck" and "living as the natives do" means not only loss of efficiency in the day's work, but also lessened powers of observation and diminished enthusiasm for the drudgery of scientific exploration.

Exciting things are always easy to do, no matter what you are living on, but frequently they produce less important results than tasks which depend upon daily drudgery; and daily drudgery depends upon good daily food.

THE QUESTION OF RATIONS

In 1915 each unit food box, as we have intimated, provided a balanced ration for two men for eight days, breakfast and supper being hearty, cooked meals, and luncheon light and uncooked. It was not intended that the men should depend entirely on the food boxes, but should vary their diet as much as possible by whatever the country affords, which in southern Peru frequently means potatoes, corn, eggs, mutton, and bread. Nevertheless each case contained sliced bacon, tinned corned beef, roast beef, chicken, crushed oats, milk, cheese, salmon, coffee, sugar, rice, army bread, salt, sweet chocolate, assorted jams, pickles, dried fruits, and vegetables. By seeing that the jam, dried fruits, soups, and vegetables are well assorted, a sufficient variety is procured without destroying the balanced character of the ration.

On account of the great difficulty of transportation in the southern Andes we have had to eliminate from the unit cases foods that contain a large amount of water and relatively little nutriment, like French peas, baked beans, canned fruits, etc., however delicious and desirable they may be. We found it possible, however, to add somewhat to the variety by providing in our warehouse at headquarters a few cases of luxuries which could be drawn upon from time to time, including such things as butter, tea, catsup, kippered herring, sausages, and pancake flour. Whenever a party went out for a new trip they were encouraged to take several pounds of "extras" along, in order to break the monotony of the food boxes. Undoubtedly there is much to be gained in keeping up the spirits of the men by providing an appetizing variety on the table.

The most highly appreciated article of food in the entire list was oatmeal, which, on account of being partially cooked, is readily prepared in an attractive manner, even at high elevations, where rice cannot be properly boiled.

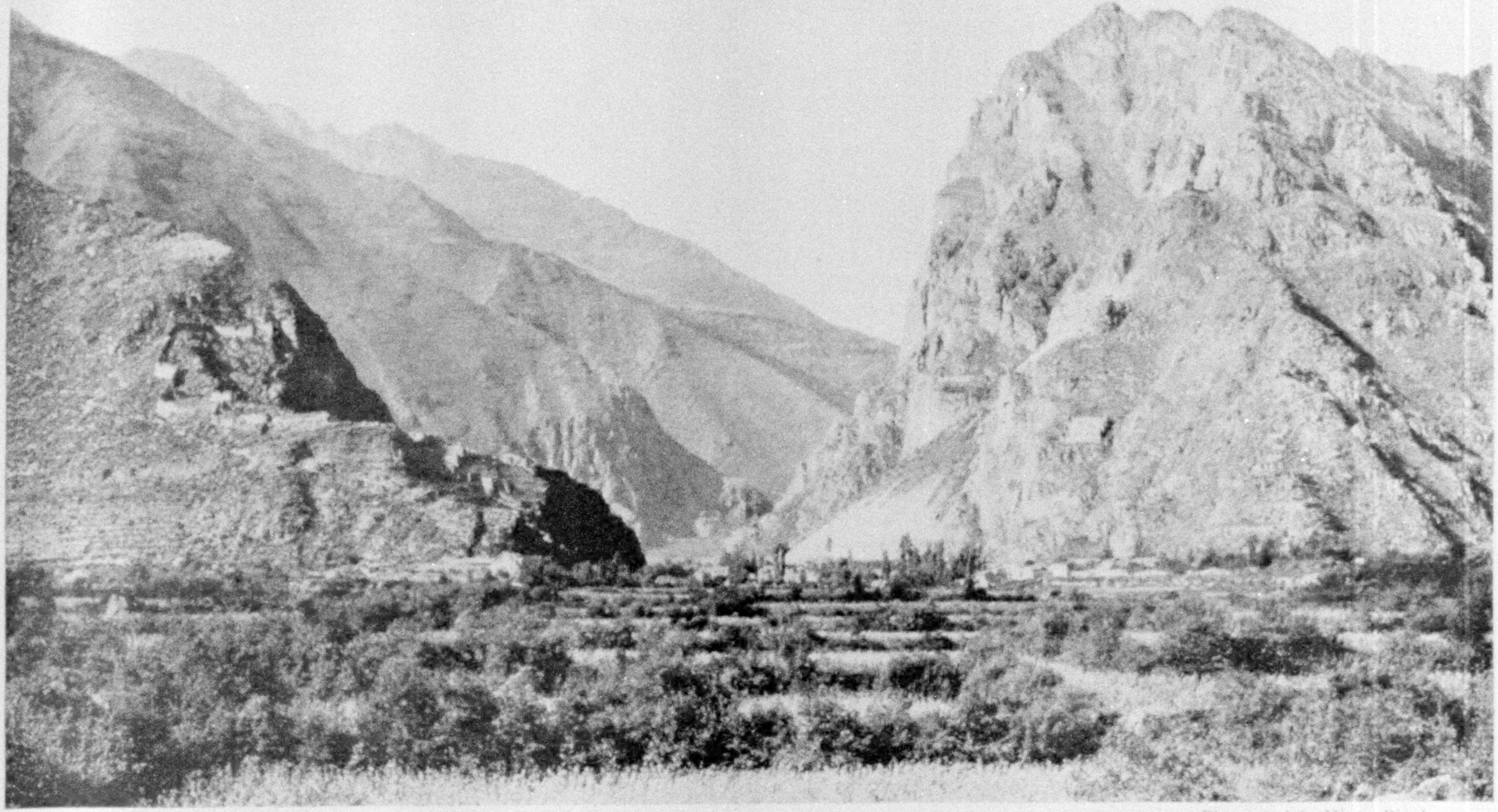
On the other hand, it was difficult to satisfy the members of the expedition by providing the right amount of sugar. At the beginning of the field season the allowance—one-third of a pound per day per man—seemed excessive, and the director was criticized for having overloaded the boxes with too much sugar. But after a month in the field the allowance proved to be too small and toward the end of the expedition had to be supplemented.

In addition to the food, we have found it advisable to include in each box a cake of laundry soap, two yards of dish toweling, and three empty cotton-cloth bags, to be used for carrying food, collecting specimens, etc.

PRECAUTIONS AGAINST DISEASE

While the food taken on an expedition largely determines the general health of the members, it cannot entirely take the place of medicines and bandages. Each camping party was provided with a "first-aid" outfit, and every man carried in his personal luggage a pocket medicine case containing quinine, aspirin, bismuth, compound cathartic, bichloride of mercury for wounds, and permanganate of potash for snake bites.

Furthermore, from previous experience we knew that it would be a great advantage to the expedition to establish a small dyspensary at headquarters, where the residents of the vicinity would be welcome and where a small supply of drugs and bandages would always be accessible. We knew that our headquarters would be at least 30 miles from the nearest drug store. Accordingly, our medical equipment was selected with this in mind. In addition, our surgeon was supplied with an African tropical field equipment, carried in a steel chest designed to withstand the hardest kind of usage and to meet all ordinary emergencies.



Photograph by Hiram Bingham

ANOTHER VIEW OF OLLANTAYTAMBO, SHOWING FORTRESS ON THE LEFT AND THE SO-CALLED "SCHOOLS" ON THE RIGHT

As an additional precaution, all members of the party were vaccinated against both smallpox and typhoid, two diseases that are likely to be prevalent in every town in the Andes. The men were particularly cautioned against drinking water taken from irrigating ditches and canals, and against drinking native beverages where the source of the water might be questionable, and against eating too freely of uncooked native fruits and such products as crude native sugar or chocolate.

The general supplies included tents provided with heavy canvas floors sewed to the walls, and mosquito nets, making the tents practically insect- and snake-proof; saddles, made especially for the narrow-backed Andean mules and fitted with cruppers and two heavy girths to prevent slipping on the steep trails; halter bridles (Peruvian saddle animals will rarely, if ever, drink without having the bit taken out of their mouths; so that the halter bridle, with its bit connected by snap-hooks, is a great convenience); pack covers to keep the loads dry during the frequent rainstorms; duffle bags of the heaviest possible material; fiber cases, and air-tight steel boxes.

Besides these things, we were prepared to furnish each member of the party with blankets, snow-glasses, folding bucket, folding wash-basin, cot, aluminum cooking outfit, small kerosene stove with Primus burner, folding brass lantern, sewing kit, canteen, pocket tool-kit, rubber poncho, Winchester rifle, Colt revolver, camera, tripod, and photographic record and calculator.

ESTABLISHING NEW HEADQUARTERS

On former expeditions we established our headquarters at Cuzco, the capital of the Incas at the time of the Spanish conquest, and one of the most interesting cities in the Western Hemisphere.* Since Cuzco is the capital of one of the largest departments in Peru, the site of most of our work, there we had the advantage of being able to keep in touch with the chief political and military authorities whenever trouble has arisen (see page 432).

In 1915, however, we decided to establish our headquarters at Ollantaytambo rather than at Cuzco, because it has a better climate (being at an elevation of only 9,000 feet above the sea instead of 11,000 feet), has plenty of good water—an important factor, considering the amount of pure water needed for photographic purposes, as well as for ordinary household use—and was a long day's journey, or 33 miles, nearer to Machu Picchu and the valleys where most of our work was to be done.

THE HOUSE OF THE YANKEES

Chief Assistant Hardy, who had left New Haven with the Expedition of 1914 and had been spending much of the intervening time studying Quichua, the language of the Incas (at present spoken by a majority of the inhabitants of the highlands), finally succeeded in renting a small place for our headquarters. It was located between the attractive stream which comes roaring down the Ollantaytambo Valley and an irrigation ditch which furnished an abundance of good water. Although not actually in the heart of the town, it was only a few minutes' walk from the telegraph station and was next door to the church and the priest's house (see page 438). Reverting to the language of the Incas, we called it Yankihausi, or the House of the Yankees.

When Mr. Hardy leased the place, there was, besides a garden and a small paddock, only a single building that was considered habitable even by the Indians. There had been other buildings, but they were in ruins and unspeakably filthy. The available building was a two-story structure. It had two rooms on the ground floor, occupied by Indian families and coated with the smoke of decades of cooking fires. One room was pointed out as the place where an Indian woman had once been beaten to death. The doors were low and narrow, so small in fact as to be well-nigh useless for light or ventilation. There were only two windows in the entire structure. Pigs and chickens,

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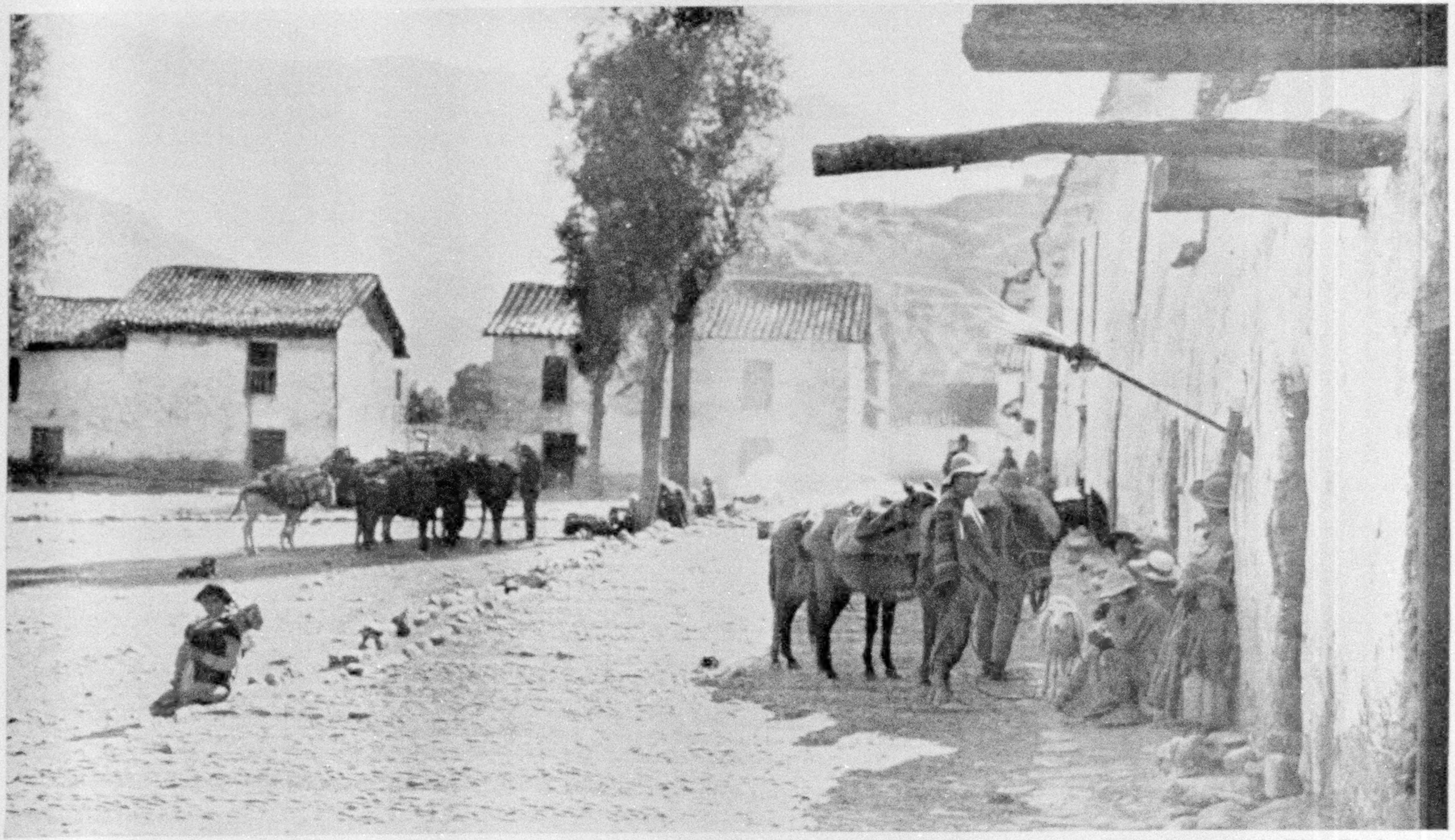
*Peru is divided not into States and counties, but into departments and provinces. The prefects of departments are answerable only to the President and have great power.



Photograph by Hiram Bingham

PACK TRAIN ON THE PLAZA: OLLANTAYTAMBO

The frayed broom projecting out from the wall over the heads of the Indians in the picture is the Peruvian method of telling the world that the place is a public house where beverages of various degrees of alcoholic strength may be had dogs and guinea-pigs roamed with impunity all over the premises.

The only building materials that could be obtained were adobe bricks of sun-baked mud, to be made from the earth and litter dug up in the courtyard, rough, unsawed Eucalyptus, grown in the vicinity, corrugated iron roofing, and Oregon pine, both of which had to be brought at great expense on muleback from Cuzco.

As a sample of the difficulties encountered in the construction of Yankihausi, Mr. Hardy writes in part:

"At the beginning of the work I had an hallucination that I could apply Yankee methods to the building of 'Yankihausi,' but this faded away after an unsuccessful attempt to teach the peons to use a wheelbarrow! The earth for the mortar was dug up with a short-handled, acute-angled hoe. Much treading served to mix straw with the mud and give it the right consistency. Both mortar and stones were carried to the wall in goatskins, where they were put in place by a mason whose utensils were a plum-line and a trowel. Two Indians mixed the mortar, three carried it to the wall, and two brought stones; so that seven laborers were employed in tending the mason.

"Furthermore, I was never able to overcome the waste caused by frequent interruptions for meals. Arriving without having breakfasted, the laborers ceased work for an hour in the forenoon to eat. Again at noon work stopped, this time half an hour for chicha and coca. About 4 in the afternoon supper was the excuse for still another rest!

"Throughout the work I was blessed with the friendly criticism of all the 'cavaliers' in the immediate vicinity. Some of this was constructive, but for the most part it was merely destructive and served only to test my powers of courtesy. All agreed that the house could not be finished in the time at my disposal.

"However, in spite of these 'Job's comforters' and such delays as feasts, which made it impossible for the Indians to work certain days, and the excommunication put upon our laborers by the local *cura,* who had conceived some wrong ideas as to the purpose of our coming to Ollantaytambo, the work went steadily on, and by April first, after five weeks' work, Yankihausi was finished and ready for occupancy."

A DAILY VARIATION IN TEMPERATURE OF 50 DEGREES

"While the health of the party was generally good," writes Surgeon Ford in his report, "with no serious illness, there were numerous disorders due to or modified by climatic conditions, or by the unusual mode of living.

"Our life was constantly in a country which varied in altitude from 2,000 feet to 17,000 feet; temperatures were encountered varying from 119 °F. to 22° F. Even in the highest altitudes there was a daily variation of as much as 55° F.

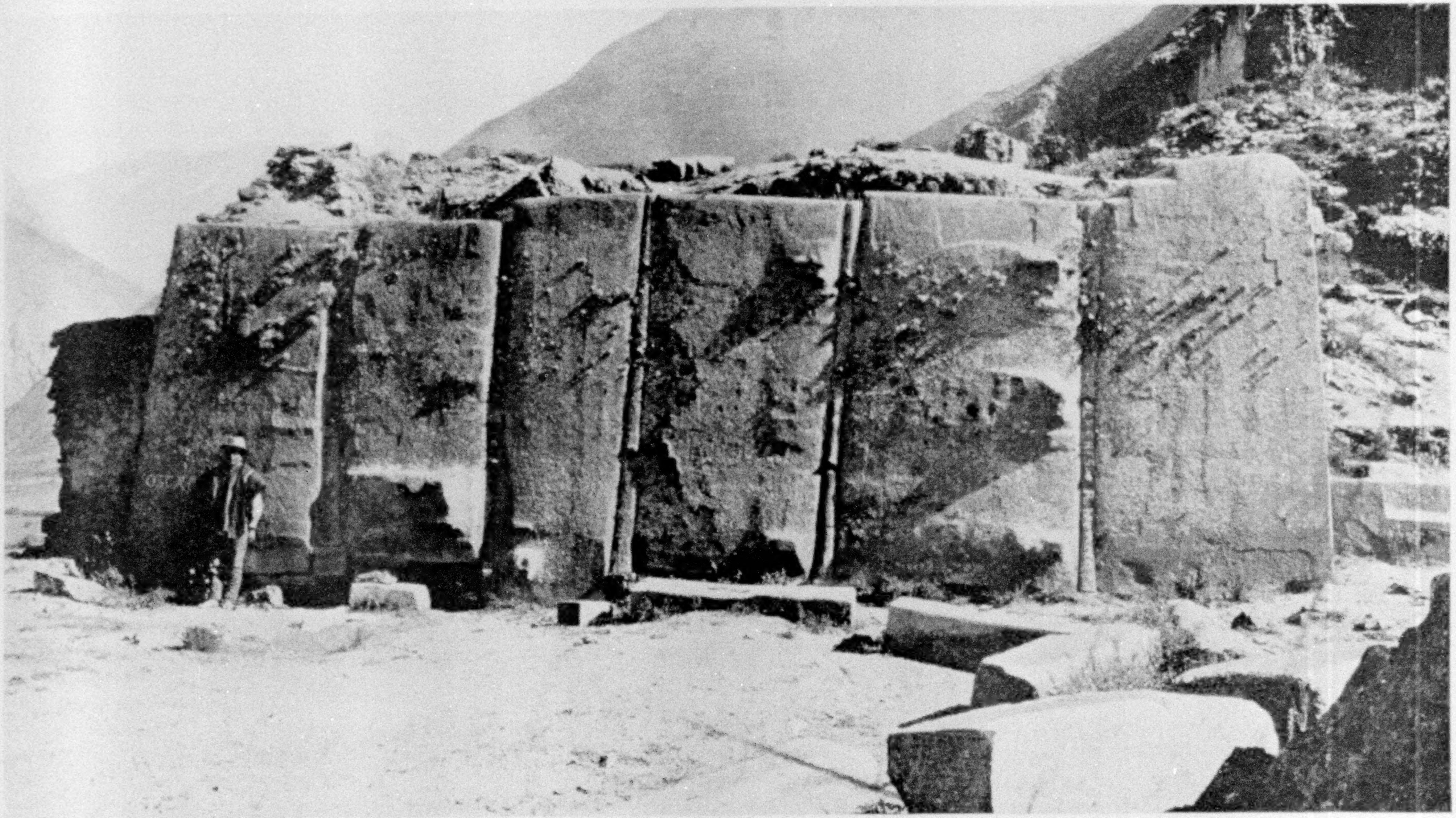
"Fleas, lice, and three varieties of biting flies were sources of much discomfort. The prevalence of typhus among the Indians toward the end of the season—one case among our own men—caused some anxiety. Affections of the respiratory passages seem to be the most prevalent diseases in the higher altitudes. There is a universal dread of 'lung trouble.' Typhoid is always present in the towns. Summer diarrhea among the children and dysentery are common.

"Typhus is endemic in the Urubamba Valley. It was epidemic during the latter part of our stay there. I had twelve cases.

"Smallpox is always present and no precautions are taken against it. Most of the adults (of Spanish blood as well as Quichuas) having had it in childhood, are immune, but it is a great cause of infant mortality.

"Open ditches in the streets are sewers, drinking-water supplies, and baths for pigs. Once at our base camp we found a fresh cowhide in our well! It had been put there, as part of a tanning process, by men who had been with two previous expeditions. These men, most intelligent of their class, could not be made to realize that the water might be injured."

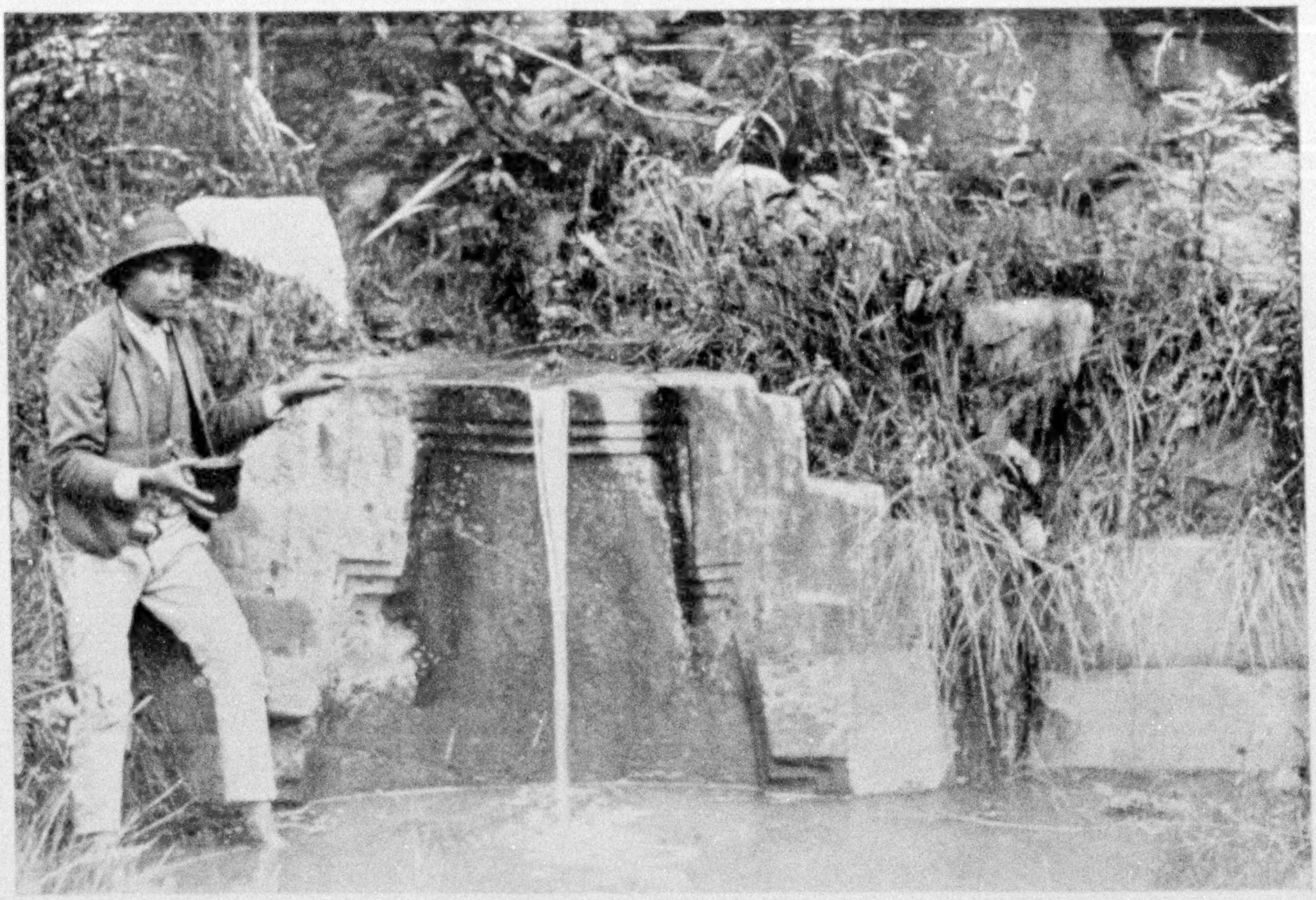
There were many narrow escapes occasioned by landslides and bad trails. We lost several mules, but no men. One of our military escorts, Tomas Cubinas, shot himself accidentally through the foot in



Photograph by Hiram Bingham

THE SIX MONOLITHS OF THE FORTRESS AT OLLANTAYTAMBO

Frowning down on our headquarters were the ruins of the great megalithic fortress, the most remarkable feature of which is this wall of six huge blocks of reddish granite; the interstices between are fitted with narrow blocks of the same material. It seems not unlikely that this ancient wall was intended to convey a sense of the majesty of the king who ordered its construction, and also a record of achievement. Although there are no real hieroglyphics to be found on its surface, it will readily be seen that there were at one time very distinct carvings and patterns that have now become barely visible, even in a strong cross-light. Unfortunately, some modern Peruvians have endeavored to achieve immortality by carving their names on these wonderful relics of the powerful megalithic civilization that preceded the Inca empire. The stones were quarried several miles away.



Photograph by Hiram Bingham

INCA PRINCESS' BATH, NEAR 1915 HEADQUARTERS: OLLANTAYTAMBO

August, the bullet passing through his instep and affecting some of the small bones. He has recovered. One day, as Mr. Heller was crossing the Cosireni River on one of the rickety native bridges, which requires a person to proceed on all fours, like an ape, the savage carrying the shotgun exploded it accidentally when midway across, the shot striking between Mr. Heller and the Machiganga Indian. Some of the shot cut the skin of his hand and another landed in my cheek, while the savage was struck below one eye by a shot reflected from the rocks near the bridge.

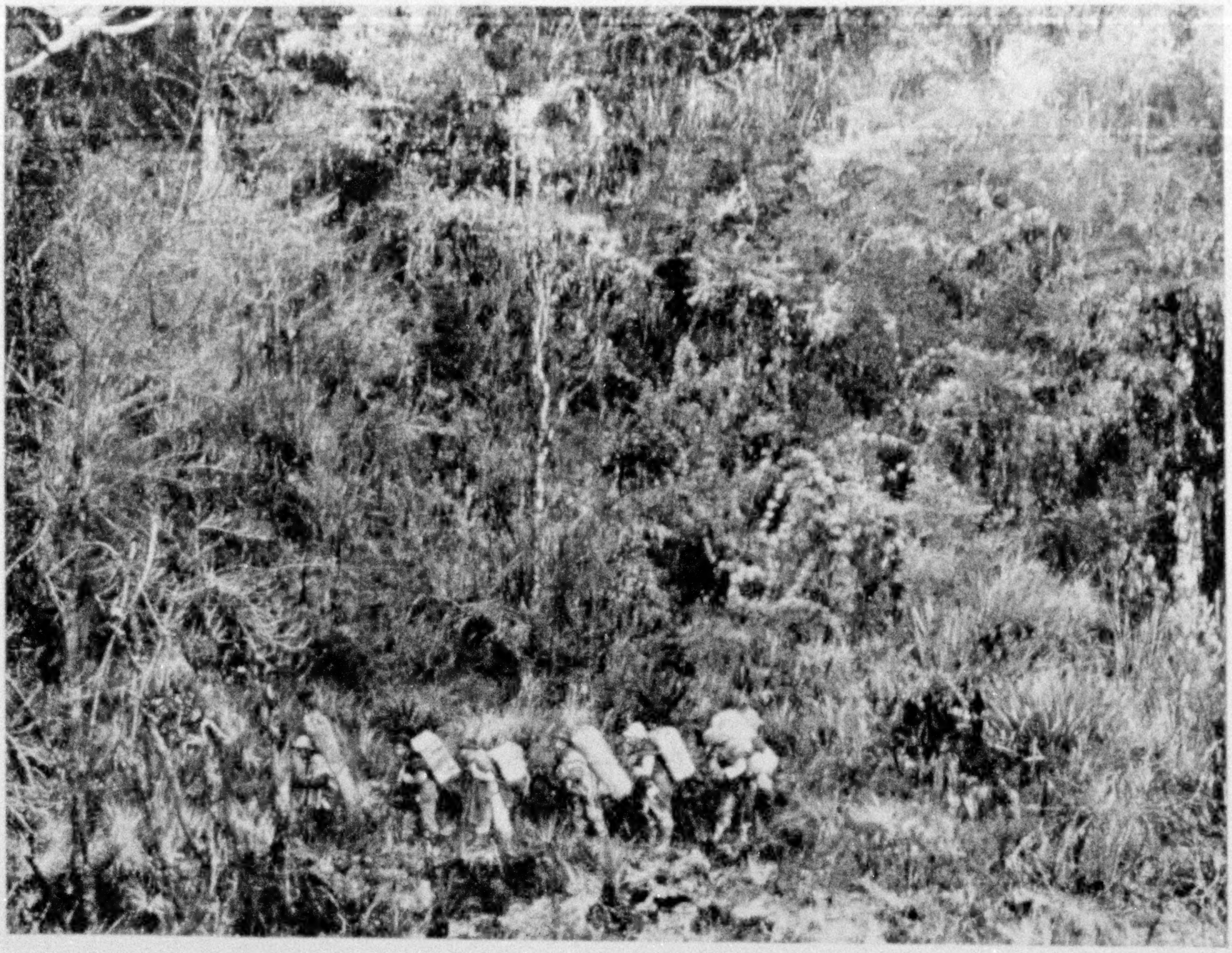
THE SEARCH FOR OLD HIGHWAYS LEADING TO MACHU PICCHU

The most thrilling moment in my four expeditions into the interior of Peru was at Machu Picchu, on the 24th of July, 1911, when I first saw the Temple of the Three Windows and the Chief Palace.

In order to reach them, it had been necessary to follow an Indian guide through a dense jungle, and finally along precipices where one literally had to hold on with one's finger nails. Clearly this was not the way that the builders of Machu Picchu had approached their city. There was another path on the other side of the ridge, but this trail was also one that could hardly be conceived of as a highway to the city, for in several places it has to depend on rickety little ladders and protruding roots.

Later we located part of an ancient road leading back from the city up the mountain side and across the face of one of the towering precipices on Machu Picchu Mountain. It appeared to proceed in a southerly direction into a region of high mountains, deep valleys, and well-nigh impassable jungles. In 1915 it was my privilege to penetrate that unexplored country back of Machu Picchu, visit its ruins, and follow its ancient trails.

The most important ruin in this region is called by the local Indians "Patallacta," or the "City on the Hill," at a place called Qquente, or "Humming Bird," which was probably the largest city tributary to Machu Picchu. We spent two months executing a careful survey of the town and making small ex-



Photograph by Hiram Bingham

OUR CARRIERS ON THE OLD INCA TRAIL TO THE LOST CITY OF THE INCAS

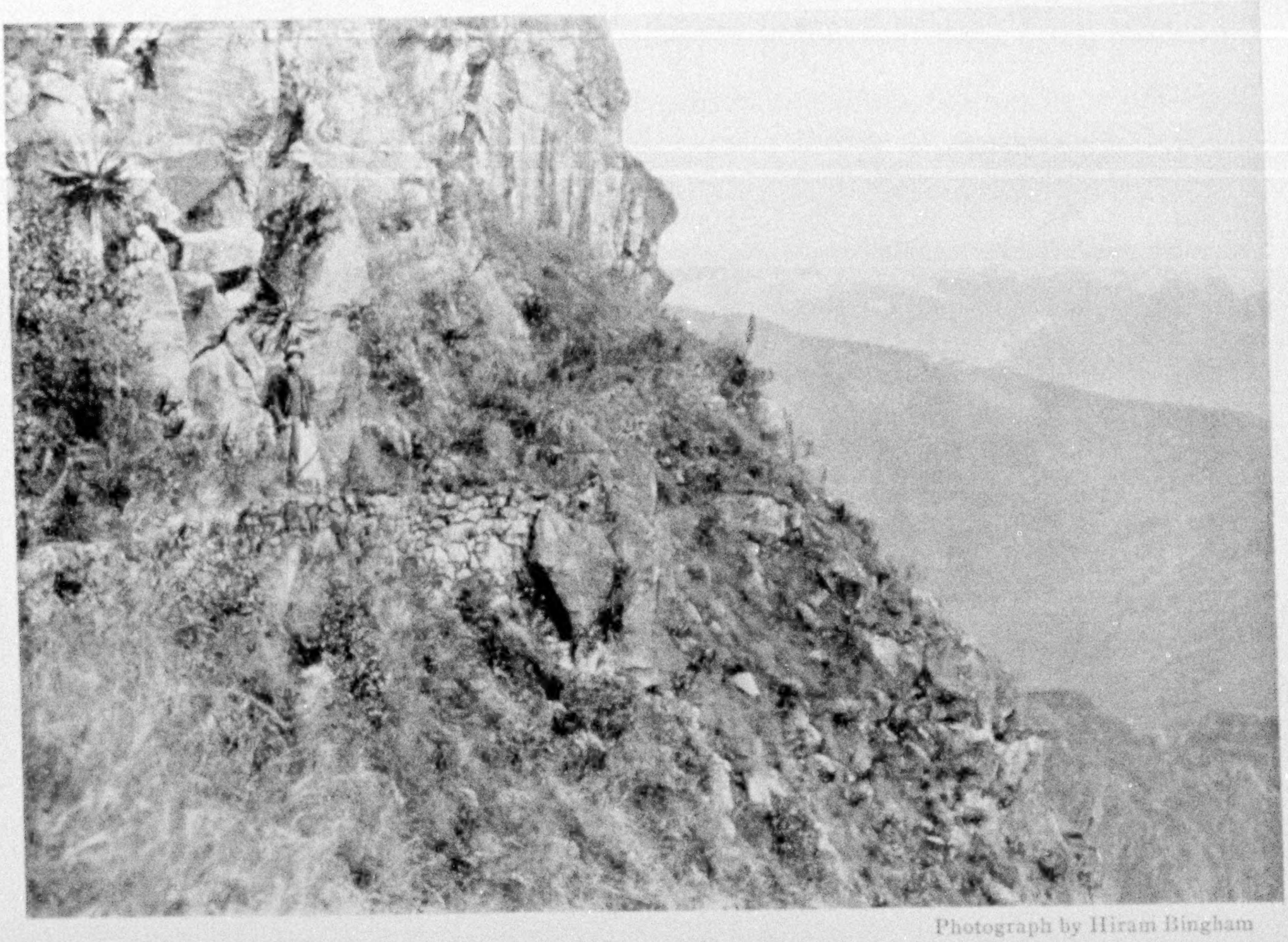
This trail connected the city of Machu Picchu with some of the more populous valleys in the vicinity and also with the distant city of Cuzco. It was opened with great difficulty by the Expedition of 1915, repaired in some places, and found to lead past several hitherto-unknown groups of ruins of minor importance.

cavations in each of its houses. In no case was it necessary to dig down more than a couple of feet, since what material there was lay very near the surface. This work was under the personal supervision of Mr. Elwood C. Erdis and Mr. J. J. Hasbrouck. Their task was well done.

Notwithstanding the extraordinary stories circulated among the Indians of our discovering gold images and other treasures of great value, no gold of any sort was found in any of the excavations at Patallacta, Machu Picchu, or elsewhere in Peru.

In the immediate vicinity of Patallacta we noticed many signs of ancient irrigating ditches, ruins of smaller villages, and occasionally ruins of well-built houses; but in no case is there anything as good as the best stone-work at Machu Picchu. The marked architectural characteristics of the Machu Picchu buildings, such as houses with gable ends, ring stones, niches, windows, projecting cylinders, and clan groups with lock-holes were well represented.

Not far from Patallacta, in the Huayllabamba Valley, we located the remains of an old Inca road leading out of the valley in the direction of Machu Picchu. It was with mingled feelings of keen anticipation and lively curiosity that Mr. Hardy and I, with a gang of Indian bearers from Ollantaytambo, in April, 1915, set out to discover how far we could follow this ancient road. After passing through a picturesque primeval forest, we came out in the upper part of the valley on grassy slopes, where we had no difficulty in tracing the remains of the ancient highway. It led to a pass at the



Photograph by Hiram Bingham

A PART OF THE OLD INCA TRAIL LEADING TO MACHU PICCHU

In places the trail was held in position by high retaining walls. The gradient was heavy and there were many long flights of stone steps (see page 448).

head of the Huayllabamba, and then down by a series of sharp zigzags into the Huayruru Valley, where not a soul lived and which seemed to be extraordinarily destitute of even wild animal life. It has the reputation of being extremely unhealthy.

We made our way through the bottom of the valley as best we could. The trail disappeared for a while in a maze of boulders and the remains of a fairly recent landslide, but we could see a road winding up the grassy slopes on the other side of the valley. We finally made out two roads and decided to take the one to the right, as that appeared to lead in the direction of Machu Picchu.

WE DISCOVER MANY MORE ANCIENT RUINS

Half way up the mountain side, 1,500 or 2,000 feet above the bottom of the valley, we came to a very interesting little ruin, the name of which the guide, who arrived a little later, told us was Runcu Racay. It was apparently a fortified station on the old highway.

From Runcu Racay the ancient highway led over another pass into the Aobamba Valley. In most places the road was in such condition that the mules could follow it with safety, but occasionally the poor animals would get bad falls and had to be entirely unloaded and helped up slippery or precipitous rocks. We had not proceeded far into the Aobamba Valley before we came to a fork in the road. The left branch led by a series of steps up a precipitous slope to a promontory, where we found a group of ruins, to which our guide gave the name of Cedrobamba. This was probably an important fortress, since it commanded the approach to Machu Picchu. It is surrounded by cliffs and is extremely difficult of access.

We made a small clearing in the valley near the ruins and camped here while the road was being made passable for the mules. In several places bridges had to be constructed.

While the road was being opened I went on ahead with two native assistants, and was delighted to find that our trail clearly led in the direction of Machu Picchu. Pushing on in the hope of soon getting a glimpse of Machu Picchu Mountain, I stumbled on a group of ruins called "Ccorihuayrachina."

On the mountain side above the ruins a hilltop had been leveled off and a retaining wall built, so as to make it a useful signal station, or primitive fortress. Beneath it we found a huge cave. The next day, on coming around the bluff in sight of this cave, imagine our surprise and delight to see a black "spectacled" bear browsing in the shrubbery. This was the first time that any of us had ever seen an adult Peruvian bear feeding in the open.

The bear was slowly working around the ridge in our direction, and in the hope of getting a near photograph of it I slipped back out of sight and climbed as fast as I could. A rapid climb at that altitude (the elevation was about 12,000 feet) is not conducive to being able to hold a camera steady when the need comes. Unfortunately the bear climbed faster than I did, and, getting to the top of the ridge, was startled by the sight of our caravan approaching. All I saw of him was a momentary glimpse of two big ears and a black snout not 50 feet away. Before I could get the camera focused the apparition disappeared, and by the time I reached the top of the ridge our precious visitor was safely hidden in the densely wooded hillside below the crest of the ridge.

Naturalist Heller, learning of our encounter with the spectacled bear, later came into this region to hunt and secured several specimens of this rare bruin.

From Ccorihuayrachina the trail led along the crest of the ridge, slowly descending toward Machu Picchu Mountain (see illustration, page 480), but when within rifle shot of the city suddenly disappeared; but that did not worry us, for we had actually reached the immediate neighborhood of the celebrated hidden city by what was probably the ancient highway that connected Machu Picchu with Cuzco. In addition, we had also been so fortunate as to locate a number of hitherto-unknown ruins that represent stations at convenient intervals along the road.

A PERILOUS UNDERTAKING

As I had now other matters to attend to, I requested Mr. Maynard to see what he could do to complete the last link of the old road.

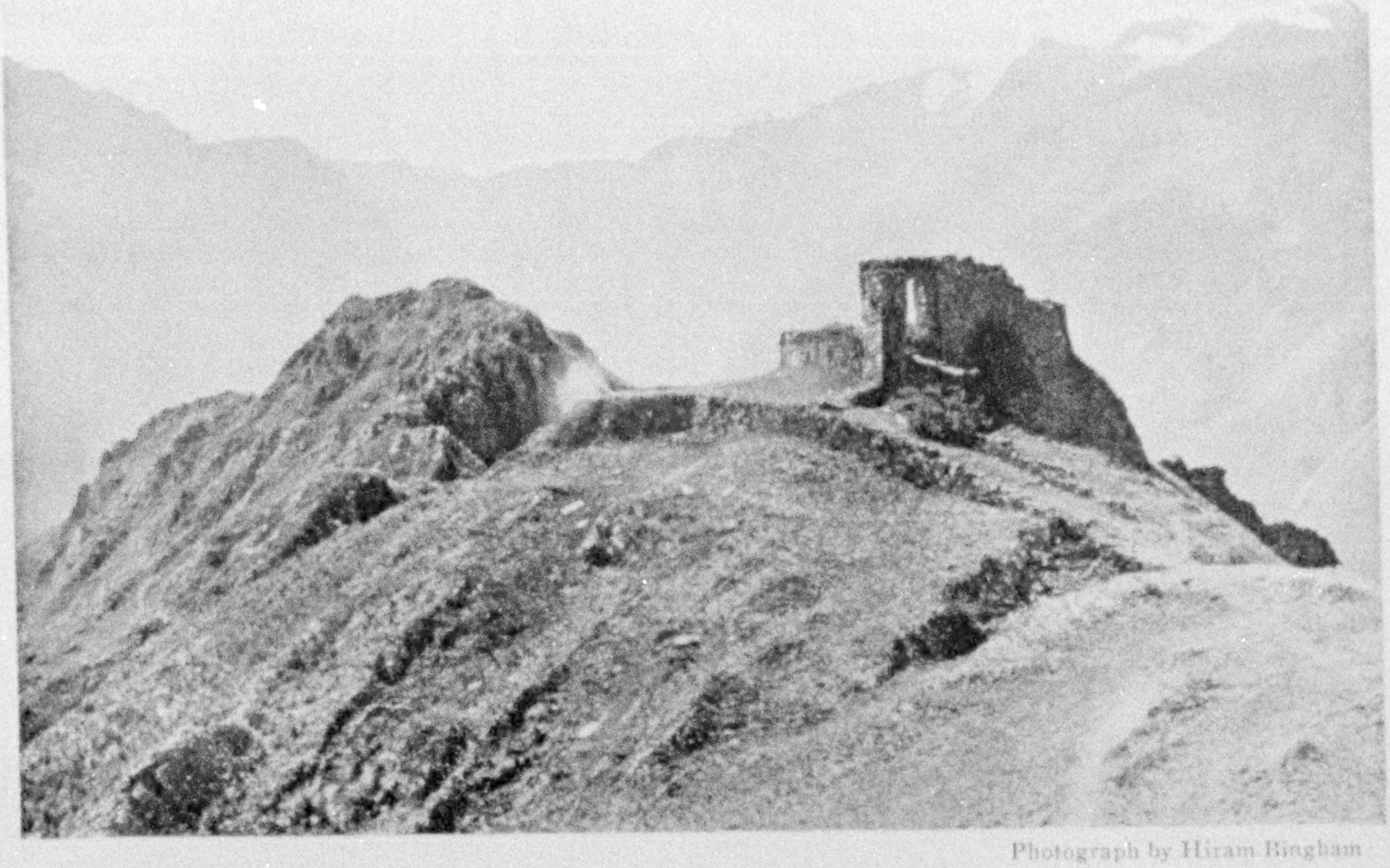
Describing his work, he writes as follows:

"We finally picked the trail up in a ruined guard-house farther along the ridge and followed it to a point where the side hill merged into a sheer rock wall. At the difficult places the Indians would try in every way to discourage further search, crying, 'No hay camino,' or 'Manan pasanchu,' meaning that 'There is no road,' 'You can't pass.'

"They worked only half-heartedly and had to be repeatedly encouraged.

"In searching for traces of the trail, one of the men finally uncovered a flight of stone steps buried in rotting vegetable matter. These steps led to a cave, the entrance to which had been concealed by bushes. By carrying their road through this natural tunnel, the Incas had avoided building on the face of the cliff. However, when we attempted to follow this route we found the passage choked by large rocks; the roof had caved in. The only possible means of advance was by swinging a short rustic bridge along the face of the cliff, which seemed rather dangerous and not too feasible.

"Sending a man back to camp for a rope, the rest were set to cutting poles which could be used to span the gap. Projecting from the face of the cliff about ten feet beyond the end of the trail and a few feet above it was a ledge of rock. Growing out of crevices at the end of this ledge, and also at the end of the trail, were two small trees. They were rather unsafe foundations, but they formed the only means of further progress. Poles were laid from tree to tree. One of the Indians then slid across, first having a rope tied tightly about his body, the other end being held by the men.



Photograph by Hiram Bingham

A HILLTOP TEMPLE

Among the ruins of lesser importance discovered in 1915 was this hilltop temple, located in a commanding position about 4,000 feet above the bottom of the Urubamba Valley, near Ollantaytambo.

Small sticks were lashed at right angles to the poles and where possible were wedged into cracks in the face of the wall. Brush and moss placed on this support completed the bridge, which was about two and one-half feet wide.

"After crossing we picked up the trail as it left the cave, until a point was reached where slides and dangerous precipices made further progress absolutely impossible. There was nothing to do now but give up all attempt to get through from this end. I therefore decided to descend into the canyon, go to Machu Picchu by the existing trail, and work back from the ruins toward the old road.

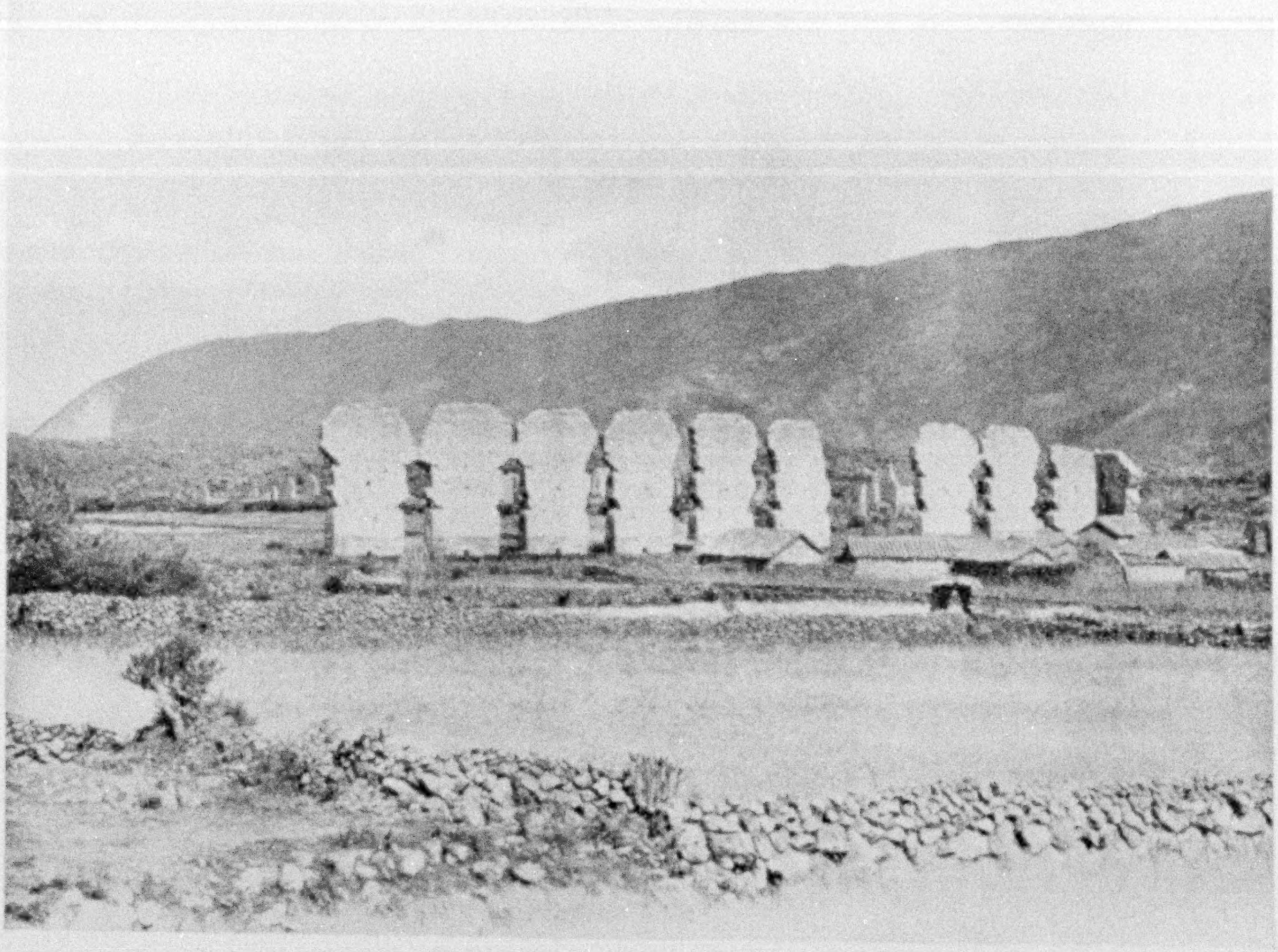
"We finally came across an Inca roadway leaving Machu Picchu by way of a deep gully. Cutting was not difficult here and we made rapid progress. The trail was the finest example of Inca road construction that I had seen. The road finally divided, one branch continuing up the mountain side, the other traversing its western slope. The latter proved to be the desired trail.

"After two days a path was finally driven down the eastern slope to our little bridge and the old road."

A few days later I had the satisfaction of picking up the old road where I had left off some weeks before and completing my journey into the city over all that is left of the ancient highway.

ANOTHER OLD HIGHWAY

The route followed by the early missionary priests on their visit to Vilcabamba the Old—a story referred to in the February, 1915, number of the NATIONAL GEOGRAPHIC MAGAZINE, on pages 180-183—we realized, probably lay across a large, unexplored area, unknown even



Photograph by Hiram Bingham

RACCHE OR RACCHIPATA: VIEW FROM ANOTHER OF THE SPRINGS

The ruins of the Peruvian highlands from the temples to the terraced mountains proclaim a race the destruction of whose annals was a calamity to mankind

to the local land-owners. We had heard rumors that there was a trail by which Indians sometimes came to the ranch of Huadquiña from the village of Pucyura, without going around through the Vilcabamba and Urubamba valleys.

So it was determined to make a circuit from Ollantaytambo, going between the beautiful snow peaks of Salcantay and Soray to the unexplored country lying between Yanama, Arma, and Pucyura, returning by way of the trail to Huadquiña, if it could be found.

Below Yanama we camped on a ridge near some small ruins. From here we made our way to Arma as best we could without guides, following trails that sometimes led nowhere and that at other times led deep into dense jungles and across mountain torrents.

On this trip I observed near Arma a forest located on the slopes of Mt. Soiroccocha, between 15,000 and 16,000 feet above sea-level—so far as we know, the highest forest in the world.

Near Pucyura, in the Vilcabamba Valley, on the hill called Rosaspata, or "Hill of Roses," where, in 1911, we discovered the ruins of Vitcos, the last Inca capital (see pages 511-520 of the April, 1913, NATIONAL GEOGRAPHIC MAGAZINE), we found encamped Messrs. Erdis, Hasbrouck, and Dr. Ford, of our expedition. They had uncovered an extraordinary amount of modern material, including horseshoe nails, scissors, Spanish brass saddlery decorations, and even jew's-harps, showing that the group of buildings back of the Palace of Vitcos was undoubtedly occupied by Spaniards in the colonial period.

Inquiry among the natives of the valley finally resulted in our securing the services of an Indian guide who said he knew the trail across the unexplored area to Huadquiña in the direction of Machu Picchu.

Our route lay up the Colpa Valley, which I had explored a few days before, passing by an abandoned quartz-crushing

Photograph by Hiram Bingham

CHILDREN BEFORE A BUTTRESS OF THE CHURCH: RACCHE OR RACCHIPATA

Showing the use of ancient carved blocks taken from the neighboring ruins of the temple of Viracocha. Their temples in ruins, their history destroyed, their civilization all but forgotten in spite of the fact that they gave to the present its most productive crop—the potato—the Peruvian Indian is a pitiable descendant of a noble race.

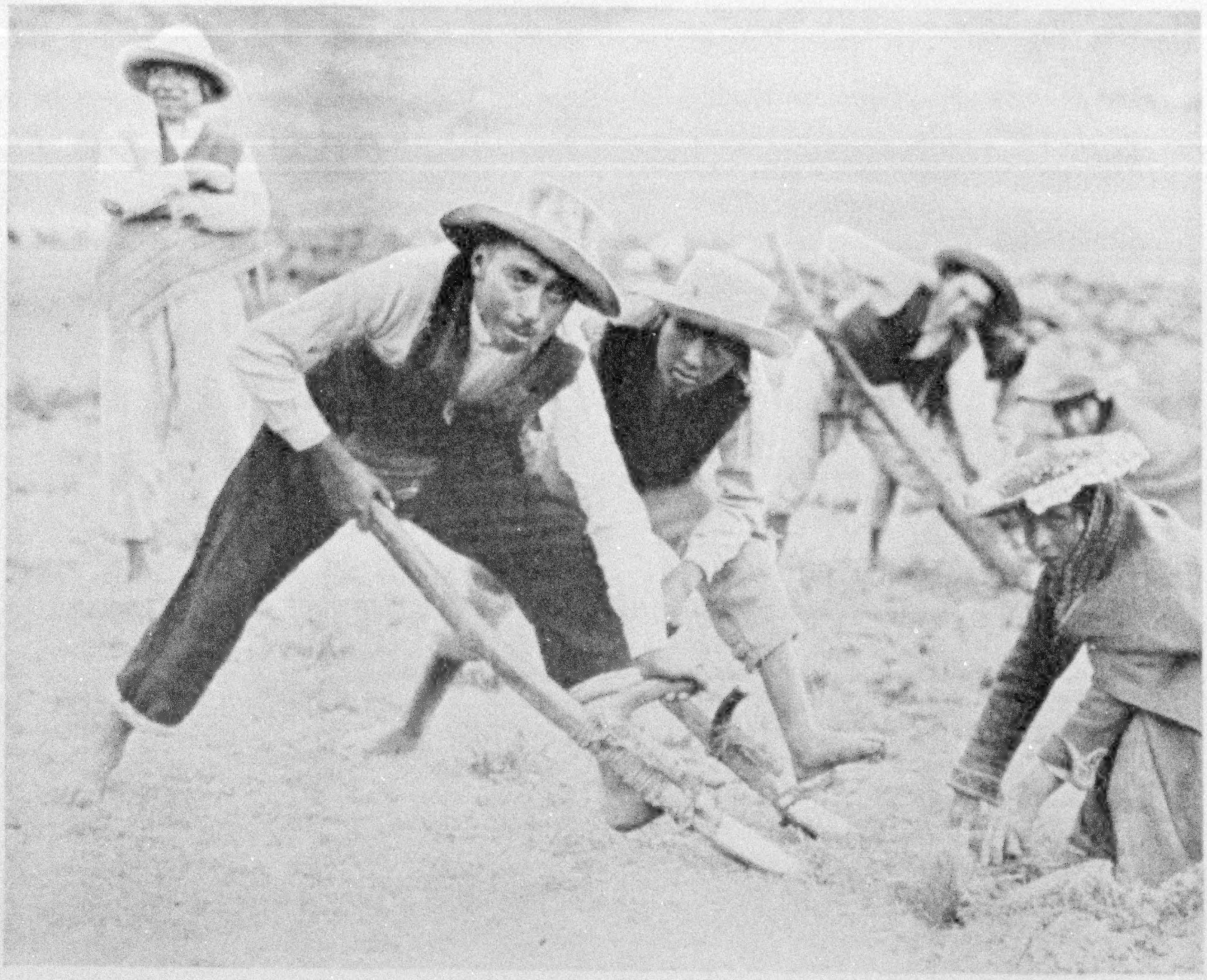
plant and discovering a long stretch of Inca roadway that leads in the direction of Choqquequirau by way of a pass called Choqquetarcarpo. This Inca roadway was in a remarkably good state of preservation, although slides prevented us from using it for our mules. Near it, and not far from the pass, we found the ruins of an ancient tavern, consisting of a group of half a dozen circular houses.

A WILD UNEXPLORED COUNTRY

From the Colpa Valley our guide led us into a wild puna country, where there were many lakes and numerous bogs. Had it not been for the remarkably fine weather of the preceding months, we should never have been able to pass through this region at all; in fact, it is undoubtedly on account of the large number and wide extent of the bogs which characterize this area between Pucyura and Huadquiña that it has so long remained unexplored by the Peruvians themselves.

At last the trail, which in many places followed the lines of an Inca highway, came to a dark green lake, larger than the rest, whose name I inquired of the guide. The answer gave me a thrill. As the guide shouted it back to me from the head of the caravan, I thought he said Ungacacha; in fact, it sounded more like this than Yanaccocha, or "Black Lake," its actual name, as I learned later.

Now, in the account of the journey of the two monks from Pucyura to Vilcabamba the Old just referred to, it was



Photograph by Hiram Bingham

PLOWING IN PERU

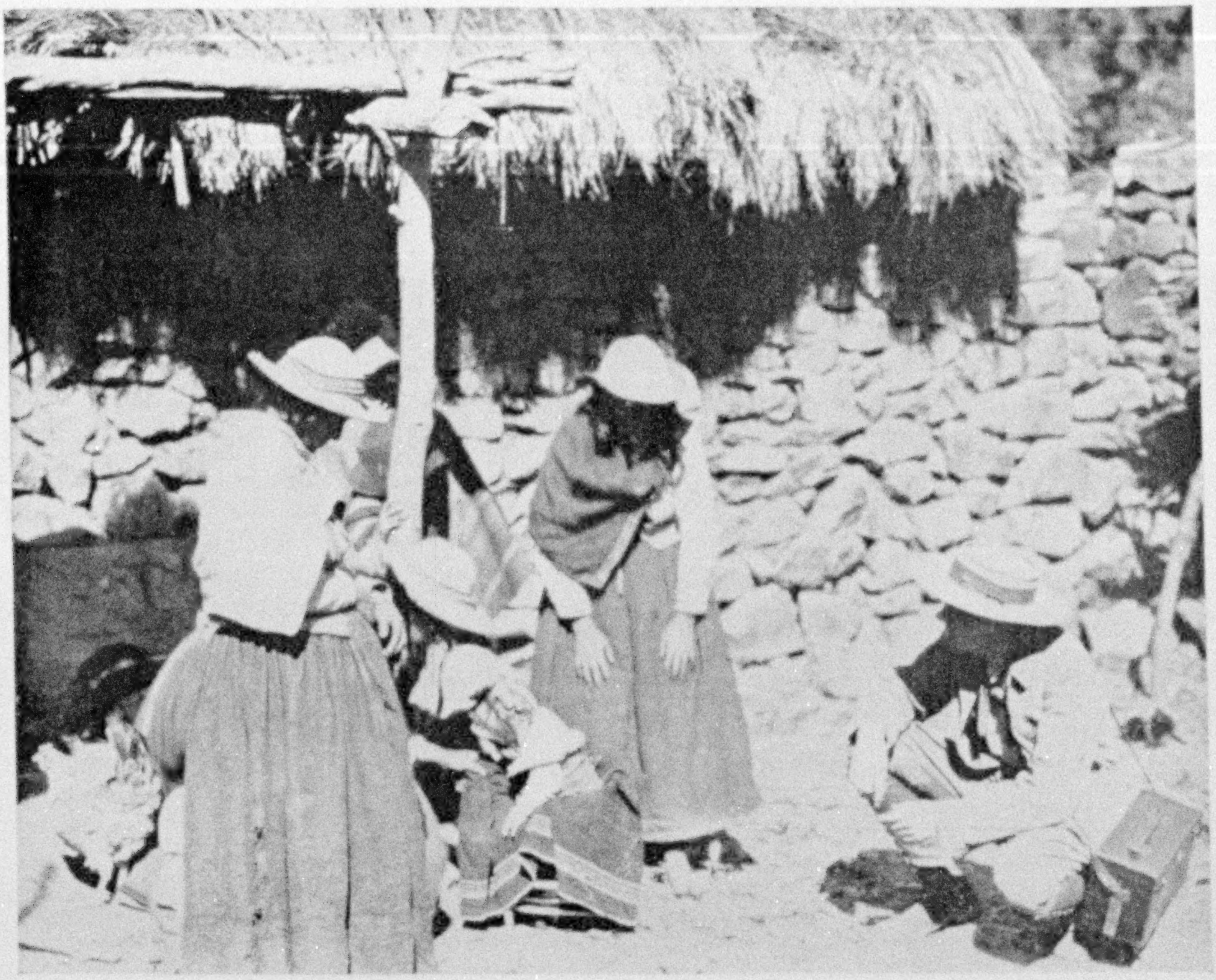
The picture shows a potato field being plowed by hand. The women turn the clods after they are loosened by a pair of man-power plows. This appears to represent the aboriginal method of cultivating the soil, but these spades are shod with iron or steel points. The handles are tied to the spades with leathern thongs. It is an Indian custom to hearten labor by working in common, and as many laborers as can be got together work on the same job at the same time. The enthusiasm that comes from working together relieves the monotony of the hard exertion in high altitudes.

stated that they had to pass a place called Ungacacha. Ever since our first journey into this region in 1911 I had been inquiring of Indians everywhere for a locality of that name, only to be met invariably with the reply that they knew of no such place.

It seems to me entirely probable that the place referred to in the Spanish chronicles was Yanaccocha, and that the monk, who probably wrote it down sometime afterward from memory, and who very likely did not hear it any more clearly than I did when I first inquired the name of the place, spelled it *Ungacacha*, instead of *Yanaccocha*. They look so different on paper that it is somewhat difficult to realize how closely the Indian pronunciation of one approaches the other.

That night we camped near a glacier at an elevation of about 15,000 feet and found that our sleep was considerably interfered with by the coldest weather we had yet encountered. The next day one of the mules overestimated the width of the narrow path and fell, carrying his rider with him. Both would probably have been killed by rolling down the precipitous hillside had it not been for the branches of a little tree which held them.

At the junction of two little valleys we found it necessary to turn away from the old Inca trail, which continued up the hillside in the direction of Machu Picchu and led toward the ruins of Yuracrumi-



Photograph by Hiram Bingham

NATIVE CUSTOMS: MESCCAY, NEAR QQUENTE

The mother carries her baby suspended in her shawl from her shoulders. When she wants to get rid of her burden she lines a little pen with the shawl and places the youngster in it. It stays there contentedly for hours.

yocc, which Professor Foote and I had visited in 1911. At that time we could not quite understand its significance, but now it undoubtedly appears to have been a station on the old Inca road between Machu Picchu and the Vilcabamba Valley.

MACHU PICCHU WAS THE CENTER OF A DENSELY POPULATED REGION

It thus appears that the builders of Machu Picchu had an elaborate system of highways throughout this little-known and almost unexplored country which lies between the Urubamba Valley and the Apurimac. This region was once densely populated, and Machu Picchu was its capital. There are no other ruins in the region that approach the Hidden City in magnificence, although there are a great many whose architecture bears a striking resemblance to the less important buildings in Machu Picchu itself.

Further study of the remains found at Machu Picchu has convinced us that we have here an essentially Inca city, using the term Inca in its most reasonable sense—that is, to designate the tribes and nations that occupied the major part of the central Andes from earliest times down to the Spanish Conquest.

The sequence of the various Andean races is extremely difficult to determine. There are no large sandy areas which, by gradually engulfing the life of a village, are later so convenient when the excavator comes to work out its stratification, as in Asia Minor and Babylonia. Landslides may sweep away in a few hours the accumulation of centuries, and overturn everything in such fashion as sometimes to place what is older actually

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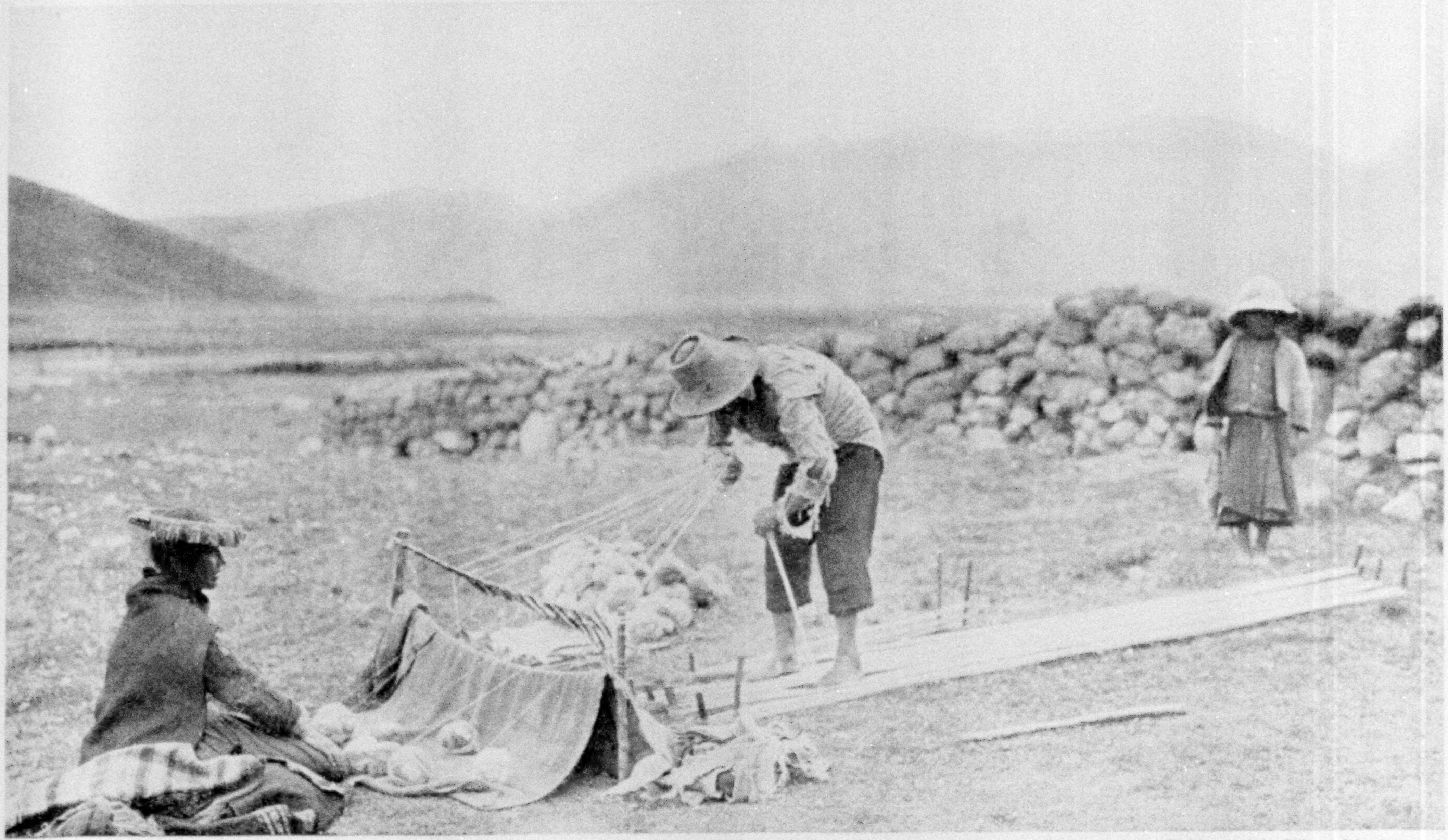


Photograph by Hiram Bingham

MAKING BLANKETS ON HAND LOOMS

This is an important ancient industry still widely practiced in the highlands of Peru. The picture shows the process of laying down the warp for a large blanket at an elevation of nearly 14,000 feet. The pattern is determined largely by the skill with which the warp is laid down.

above what is newer. The Spanish conquerors were a race of treasure-hunters, and they and their successors destroyed the majority of the evidence.

Lack of timber, the prevalence of heavy rains during part of the year, and the ease with which stone might be procured early led to the development of stone as a building material. Strength and permanence were secured through the keying together of irregular blocks. The upper and lower surface of these stones were frequently convexed or concaved, the convexity of one stone approximating the concavity of the adjoining stone.

In constructing their walls the pure arch was not evolved. They developed several ingenious devices, such as "lock-holes" for fastening the bar back of a door; "ring stones," which were inserted in the gables to enable the roofing beams to be tied on; projecting stone cylinders, which could be used as points to which to tie the roof and keep it from blowing off. The ancient builders also provided for ventilation and drainage (see the April, 1913, and February, 1915, numbers of the NATIONAL GEOGRAPHIC MAGAZINE).

POTTERY LIKE THAT OF GREECE

Sculpture in a rude form existed, but no well executed representations of the human body. They had some skill in copying animals' heads, but at best it was crude in comparison to the skill achieved by the coast peoples. A pair of dishes found in Machu Picchu, bearing as decoration roughly drawn butterflies painted in three colors, represents their highest attainment in ceramic decoration.

Their pottery is marked by simple and graceful lines, bearing a striking similarity to that of ancient Greece, and resembling in its simplicity and utility some of the modern vessels at present in use in French kitchens.

Owing to the extreme moisture of the climate, the remains of cloth are very few; but we know that the Inca peoples actually did arrive at a high degree of skill in the manufacture of textiles through their ability to procure the wool of the alpaca. By the use of hand looms artistic and intricate patterns were produced, and cloth of the utmost delicacy of texture was not uncommon.

Their metal articles were easily preserved, and so we have been able to learn that the people of Machu Picchu were extremely skillful makers of bronze.

The elaborate study of our collections by Professor Mathewson discloses the fact that the more delicate or ornamental pieces contained the maximum percentages of tin, since bronze with a high tin content yields the best impressions in casting.

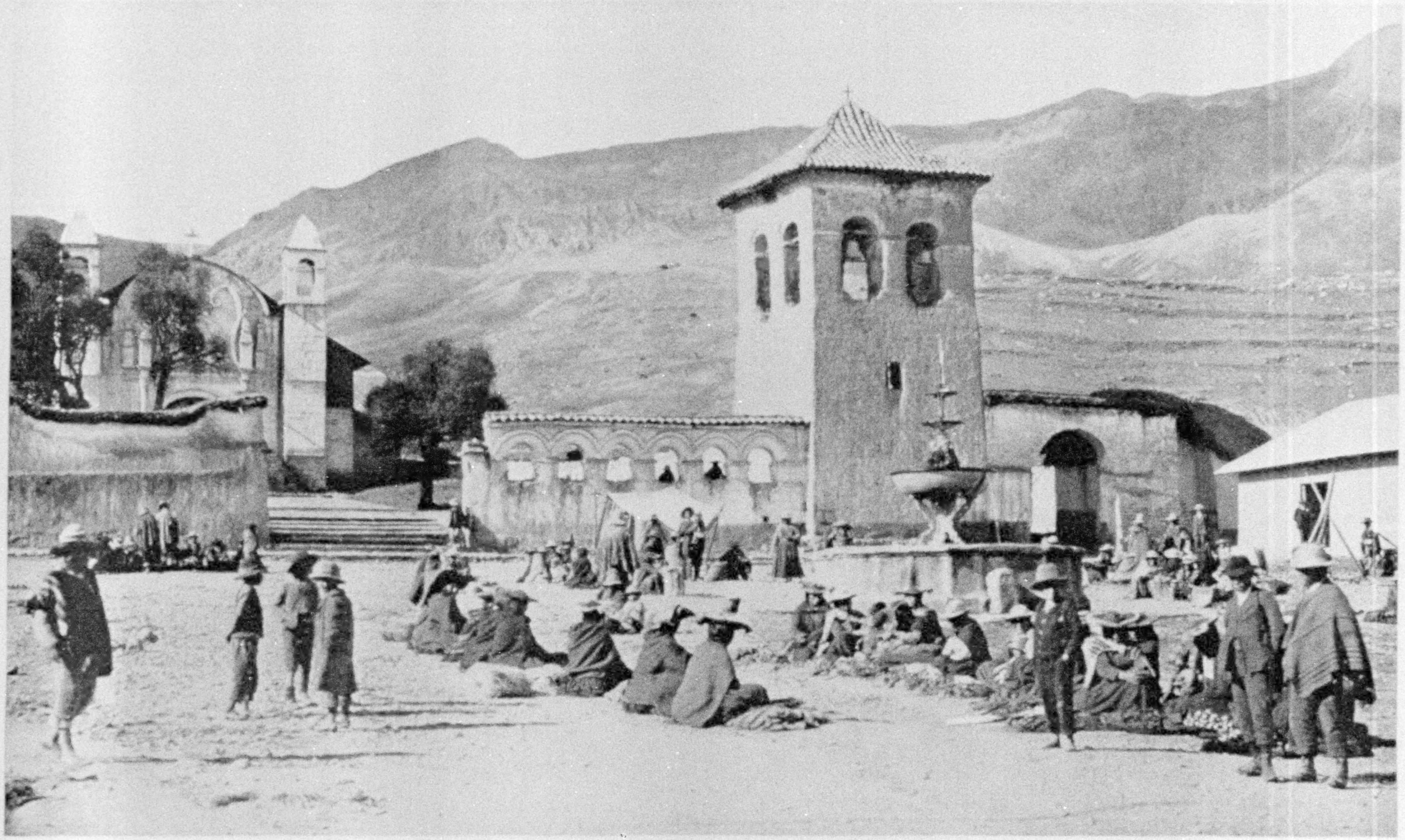
Professor Mathewson believes that the early Incas were unfamiliar with refined methods of heat treatment, and so were compelled to sacrifice extra hardness and strength by increasing the tin content in large objects, which required considerable working. Apparently cold working was invariably depended upon to produce the final stiffness and hardness of an object. This necessitated a low tin content in such objects as axes, large knives, etc.

TREPANNING OF SKULLS WAS COMMON

Their surgical tools were probably of bronze or obsidian. Surgery appears to have been practiced to a considerable degree, if one may judge by the large number of trepanned skulls that we have found in caves within a radius of 25 miles of Machu Picchu. In some cases the cause of the operation appears to have been disease; in others evidence leads to the conclusion that the operation was intended to relieve pain caused by wounds received in battle. Since the favorite weapon of the Inca peoples was the sling, and clubs were common, it is not surprising that the skulls of many soldiers should have needed the relief that came from skillful trepanning.

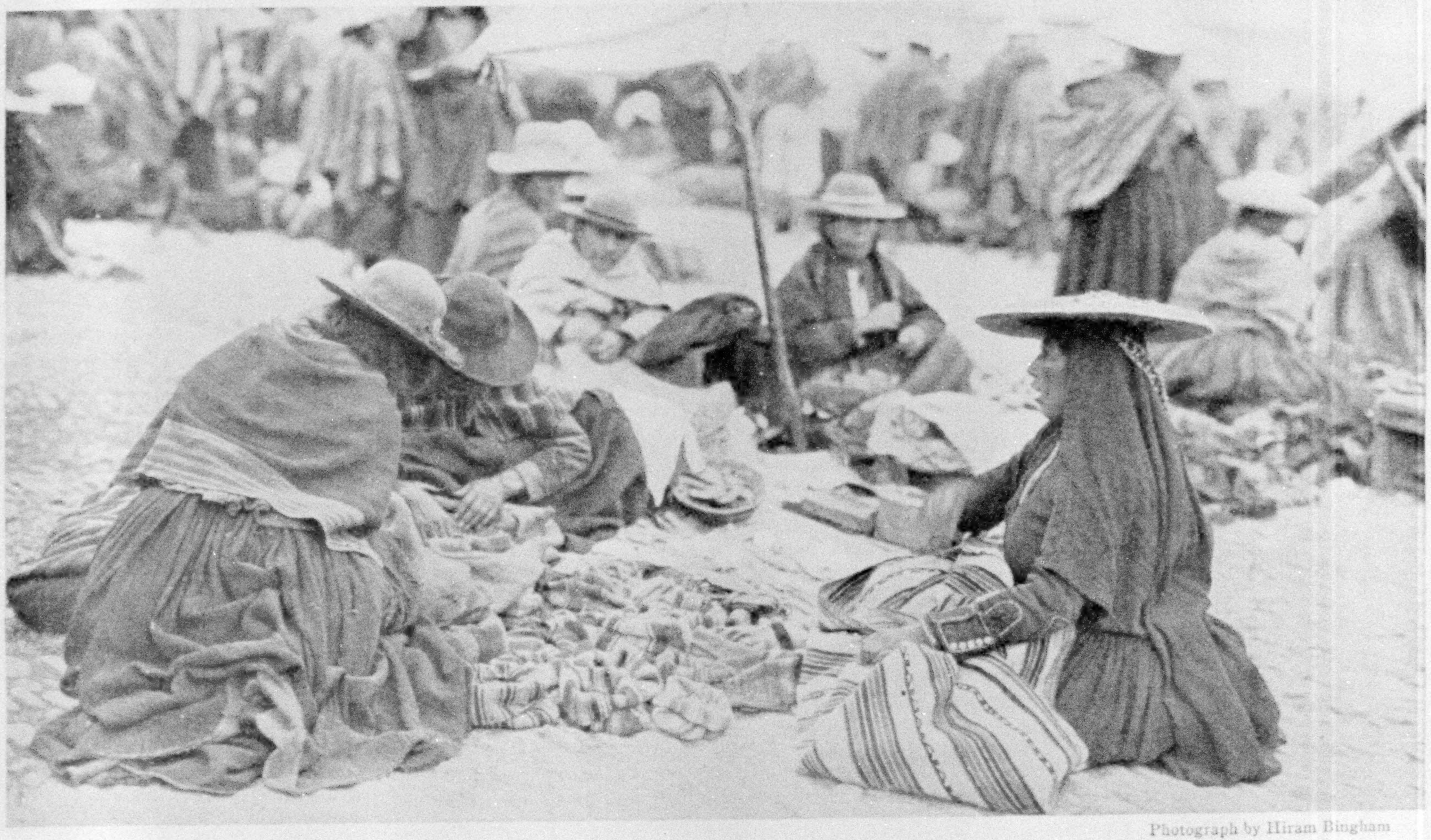
In the art of war they exhibit skill in defense rather than offense. Fortifications constructed with salients and reentrant angles so as to admit of lateral fire were not uncommon; high walls, even dry moats, were not unknown. Forts were frequently located on sightly eminences commanding a fine view of all approaches (see pages 438 and 440).

They had no machinery and did not use iron or steel. They used levers and inclined planes. They also made huge



Photograph by Hiram Bingham

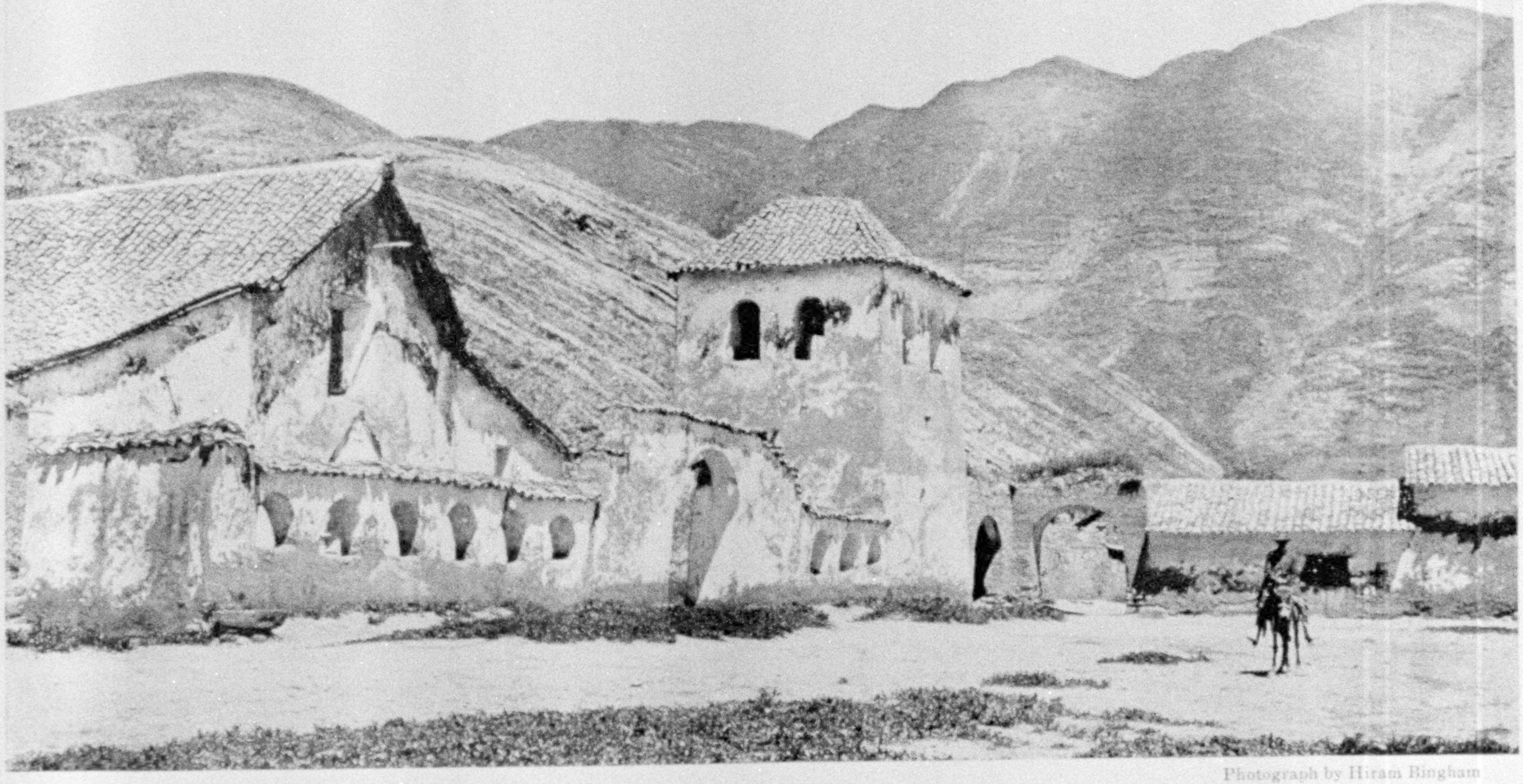
THE PLAZA ON SUNDAY AFTERNOON, SHOWING THE CHURCH BELFRY AND VEGETABLE MARKET: SANTA ROSA



Photograph by Hiram Bingham

NATIVE DRUG STORES OF THIS TYPE MAY BE FOUND IN THE MARKET-PLACES OF ALL THE LARGE CITIES IN THE PERUVIAN ANDES

The "druggist," usually a woman, has twoscore or more of remedies, each in a nicely decorated little woven bag. Some of the remedies are useful herbs; others are more fantastic, and include starfish and queer stones. About half of the remedies are supposed to be effective against the bad effects of fresh air and drafts!



Photograph by Hiram Bingham

THE PLAZA AND CHURCH OF PUCYURA ON THE ROAD FROM CUZCO TO ANTA: A GOOD EXAMPLE OF COLONIAL ECCLESIASTICAL ARCHITECTURE fiber ropes, out of which they constructed long suspension bridges. They thought nothing of handling blocks of stone weighing five tons and upward. Indeed, there are numerous stones that weigh over 15 tons which were fitted together with a skill that has amazed all beholders (see the extraordinary Panorama of Sacshuaman, published as a frontispiece to this number, and also page 436).

It appears that the Incas and their influence throughout the Andes extended no farther north than the known limits of the llamas and the alpacas; in fact, the development of their culture may be said to have depended in large measure on their success in domesticating these varieties of the South American camel so long ago that no wild members of either species remain. Their ability to raise and train hundreds of thousands of llamas which could carry from 50 to 100 pounds apiece enabled the Inca peoples to carry out engineering and agricultural works far more difficult than they could have accomplished had they been obliged to depend on human burden-bearers.

THE SUN WAS THEIR CHIEF DIVINITY

In religion the Incas were fond of worshiping high places, fine views, and other striking natural objects, such as huge irregular boulders, waterfalls, and springs; the wonders of the air and the sky, such as rain, thunder, the starry firmament, the moon, and, above all, the sun. In a cold, mountainous region like the central Andes, it was but natural that the sun, so essential to the raising of crops and to the comfort of shivering humanity, should have been regarded as their chief divinity.

Of literature as such they necessarily had none. Like most primitive peoples, they had remarkable memories. Their language was probably the Quichua. Mr. Hardy, of our expedition, who has been studying it, says that "for one who has not learned it in childhood it is difficult because of the lack of any good grammar in either Spanish or English." He then continues:

"In the fifteen months at my disposal I learned enough to enable me to carry on the conversation necessary to secure information as to trails, ruins, rivers, towns, etc., and to pass some judgment on their orthography.

"My studies make me appreciate the value of Quichua in furnishing sidelights on the life and customs of pre-Spanish inhabitants. The abundance of expressions for all stages of drunkenness shows that the millennium did not exist. The absence of words meaning to buy and sell suggests the simplicity of their industrial life. The importance of agriculture is demonstrated by their having but one word (*llank'ay*) for our words 'work' and 'cultivate.' That they had not gone far in philosophy is shown by the lack of words to denote abstract qualities. 'Pacifism' was evidently known in those days, for *aucca* was used either for enemy or soldier.

"The adjective 'imperceptible' is made up of three words, *acco-sayay-huchaylla*, meaning 'the size of little sand.' An 'incorruptible' man is one who 'does not turn to one side,' *mana-huakllik*. To 'inherit' is literally 'to take the place of the dead one,' *huañukpa-rantin-yaycuy*, while a 'grave' is 'the heart of the earth,' *allpak-soncco*.

"'Experience' is a 'ripe heart,' *pocuscca-sonccoy*, and to 'experiment' is to 'take hold on memory,' *yayay-happiy*. A 'fervent' man is one 'having a beautifully burning heart,' *sumak-raurak-soncco;* an 'inconstant' man has his 'heart on one side.' 'Foreigners' are 'those belonging to a city a great distance off,' *caru-caru-llaktayoc*, and a 'window' is 'a hole that sees,' *ccahuana-ttocco*."

So far as one may judge from the present-day music of the Andean peoples, Inca music was a very simple affair, limited to a few notes repeated continually in a minor key.

The family tie was very strong and still is. The extent to which members of a family will go in alleviating suffering and distress of distant relatives is perhaps the most striking and delightful trait in the South Americans of today.

STRANGE THAT SO ACCOMPLISHED A PEOPLE LEFT NO WRITTEN RECORD

Most unfortunate was their failure to develop an alphabet, or even some form

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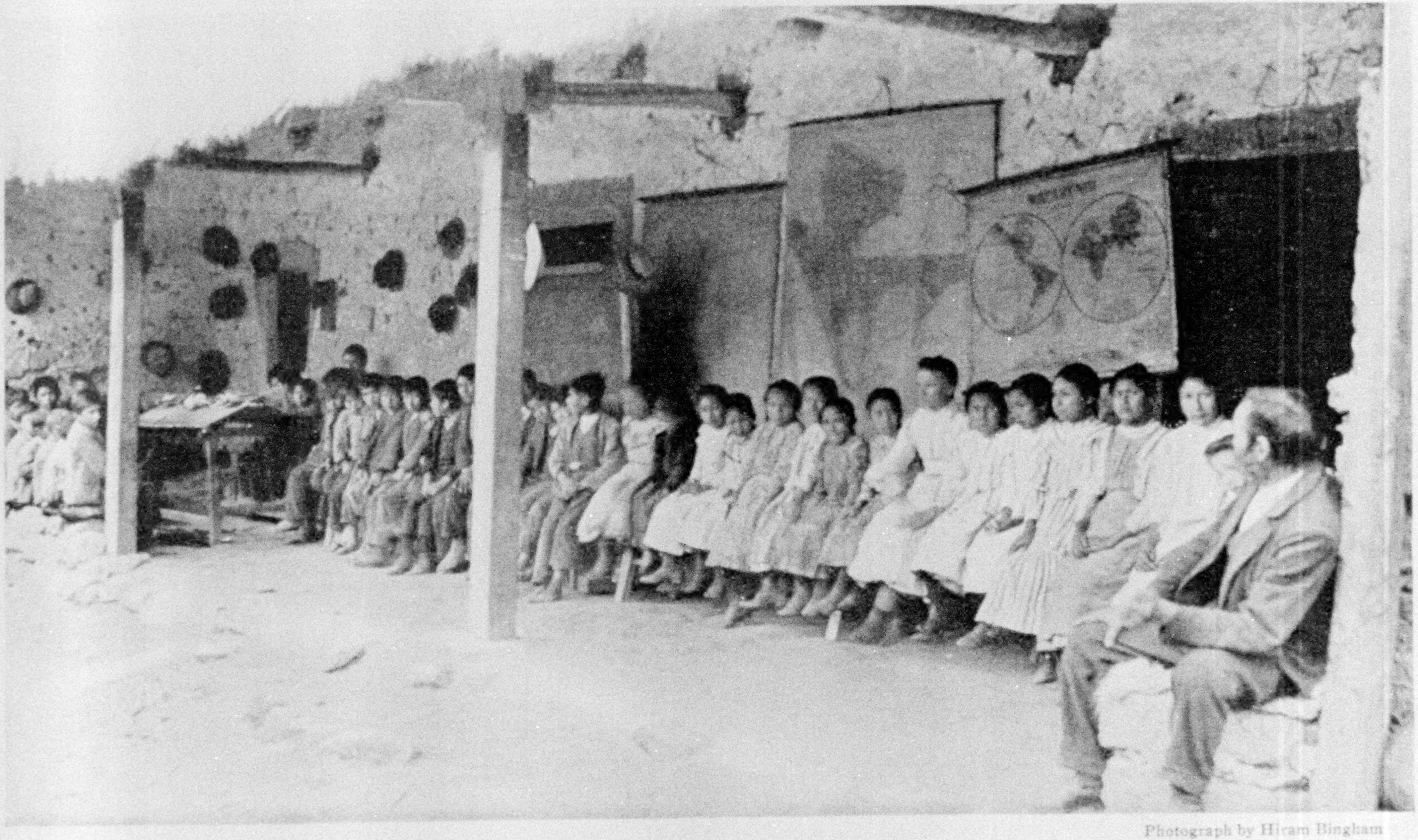
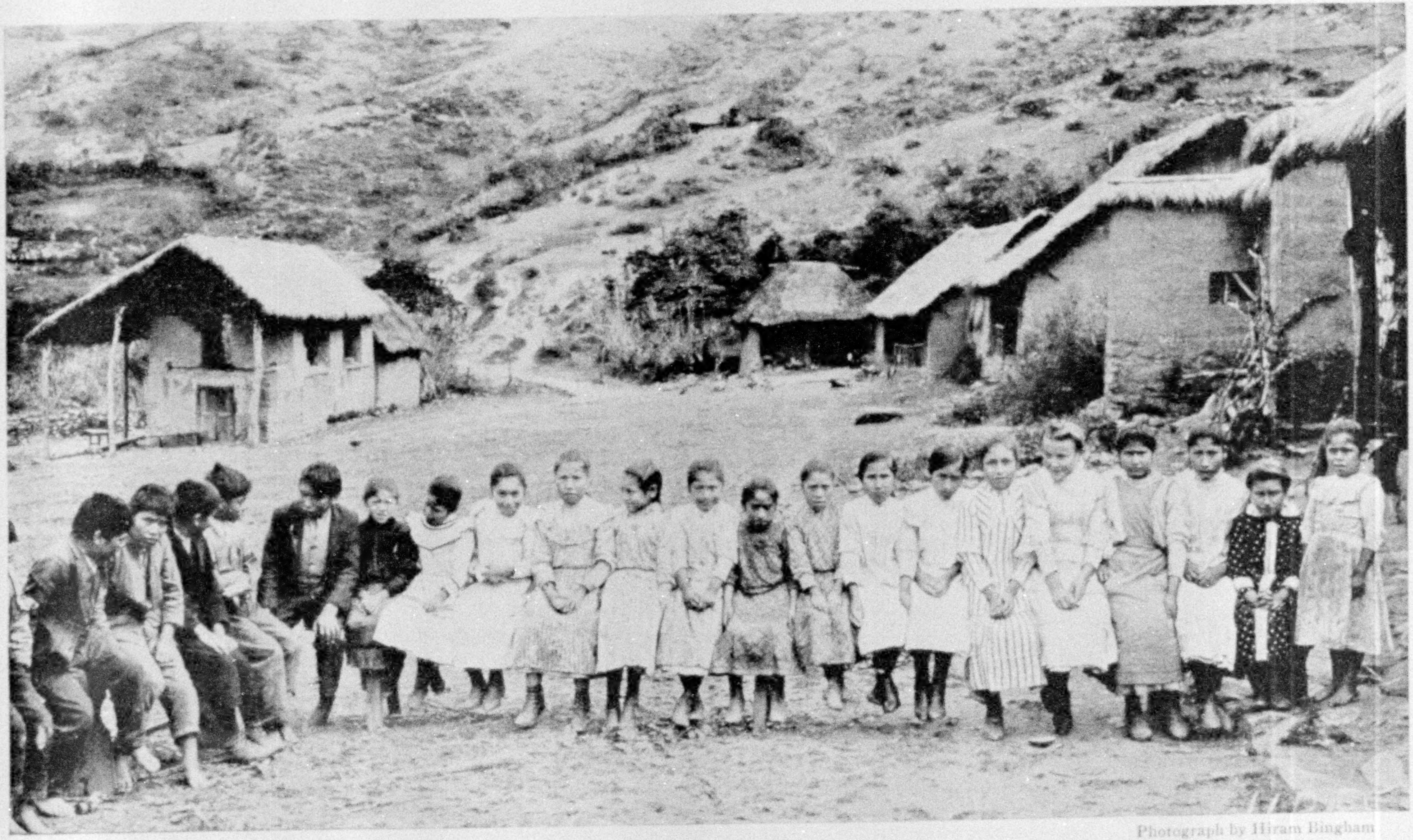


Photograph by Hiram Bingham

THE SCHOOL AT PUCYURA

When we visited the school the session was being held on the veranda, as the day was fine. The schoolmaster may be seen on the right.



Photograph by Hiram Bingham

SCHOOL CHILDREN OF PUCYURA

Nearly all the children are of mixed Spanish and Indian ancestry. They live in houses like those in the background, and others not so good. The children in the picture belong to the wealthiest residents of the vicinity. They are not dressed up for the special occasion; in fact, not even the teacher knew the picture was to be taken until a few minutes previous. This is the only school within a radius of nearly fifty miles, and many of the youngsters live so far away that they are obliged to board in the village.

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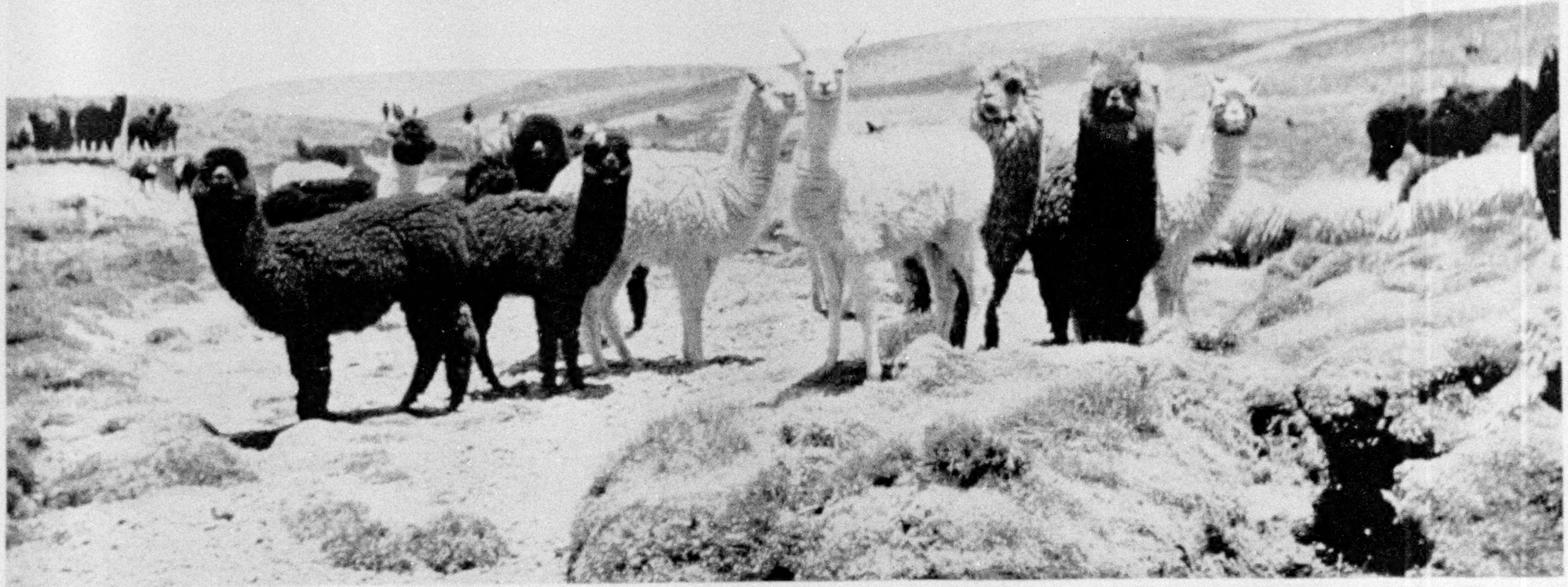

Photograph by Hiram Bingham

A FLOCK OF YOUNG ALPACAS (WITH ONE WHITE LLAMA, IN THE CENTER, AND SOME SHEEP, TO THE RIGHT) SEARCHING FOR WATER ON THE PLATEAU, 15,000 FEET ABOVE THE SEA

On the high upland pastures between Lake Titicaca and Cuzco thousands of alpacas and llamas find their natural feeding grounds. They have been domesticated for centuries and do not exist in a wild state, but are always attended by shepherds. Alpaca wool is one of the choicest exports of Peru.

of hieroglyphic similar to that which existed in southern Mexico and Central America. It is remarkable indeed that a people who succeeded in equaling the ancient Egyptians in architecture, engineering, pottery, and textiles should have fallen so far behind in the development of a written language. This is the most serious obstacle that stands in the way of our learning more of that enterprising race.

MANY BIRDS LIKE OUR OWN

So much interest attaches to the people who built Machu Picchu that we were extremely anxious to learn all we could of the animals and plants with which these wonderful architects were familiar. What birds did they see? What animals furnished them sport? Which annoyed them? What did they eat? To solve these questions Messrs. Heller, Cook, and Gilbert spent several weeks in camp at the foot of the towering cliffs that defend the Lost City. Writing of his observations, Mr. Heller says, in part:

"Birds in great variety and abundance flitted about our camp and through the neighboring forests. The Urubamba Valley acts as a highway or migratory route for birds between the highlands and the low country. I collected and noted some eighty species.

"Fly-catchers were the most numerous in species, the fifteen kinds which occurred here ranging in character from such familiar forms as our gray kingbird and black phœbe to small forest species of rich rufous tints.

"There was, in particular, a large, pugnacious cliff species and a peculiarly diminutive forest one with a remarkable voice, many times greater than the bird which uttered it.

"Our robin redbreast was represented by a drab brown species of equal size, which haunted the roadside and showed as much confidence in humanity as our bird. The Quichuas call him 'chi-wunk-koo', a name obviously derived from his call note.

"Swallows, resembling our tree-swallows in coloration, were common about the cliffs, while occasionally wandering flocks of a great swift whirled through the canyons.

"The finch family in Peru is a mere remnant compared to the wealth of species in our northern fauna. The tanagers, as a family, were the most abundant and gaudily colored birds with which we met.

"Humming-birds, usually very numerous in Peru, were here represented by only three species, one of them the most diminutive in South America. The size of a bumblebee, in flying it darted away in a straight line with great speed, quite indistinguishable from a bee.

"Another Peruvian bird familiar to the North American is the water ouzel, or dipper, a species of which was found here haunting the streams near rapids at the edge of pebbly bars, often wading thigh deep in the water or diving in shallow pools for insect larvæ. Its body is a rich seal brown and its head white.

"Among the birds of San Miguel there were no greater advertisers than the large green parrots, which passed overhead in small flocks, every member engaged with his fellows in an animated conversation of hoarse, discordant notes.

"Although we failed to get any bears near the ruins, we did trap a vile-smelling proboscis skunk, known to the Indians as the *amjas*. He dragged himself, trap and all, into a crevice between two rocks. After two shots, he seemed to relax his hold, and, assuming that he had been killed, I instructed my gun-bearer to pull him forth. When the skunk had been dragged into the daylight, we discovered our awful mistake, but too late!

UGLY VAMPIRE BATS

"On the morning after our arrival at San Miguel Bridge the pack-mules nearly all showed blood blotches on their withers and backs, where they had been attacked during the night by vampire bats which had fed on their blood. This bat, *Desmodus rotundus*, is plentifully distributed throughout Peru in altitudes below 10,000 feet.

"It is one of the most highly specialized species of existing bats and is a member of the *Phyllostome* or leaf-nosed group. It has, however, lost its leaf nose to a large extent, owing to its abandonment of an insect diet. The lower jaw is

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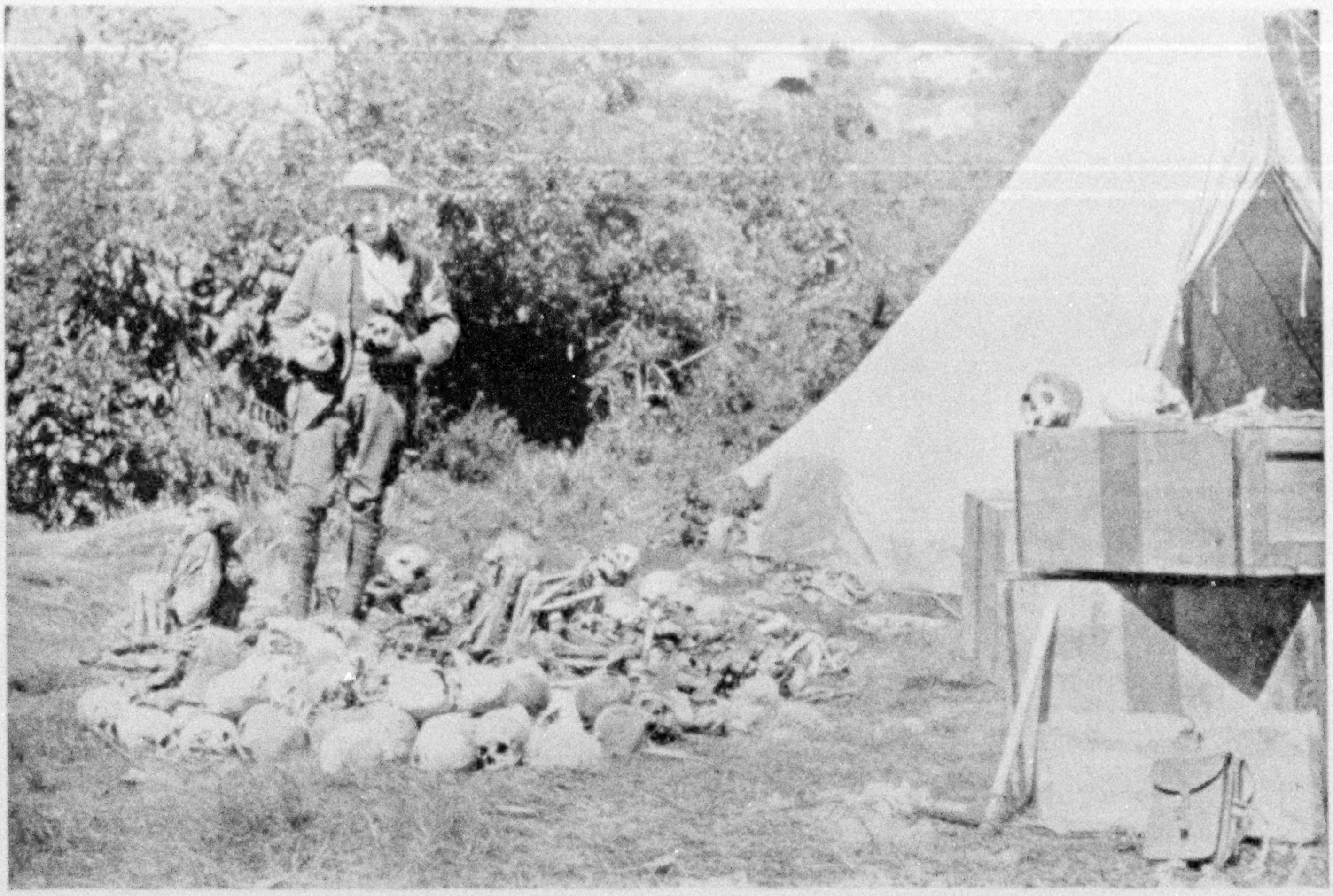
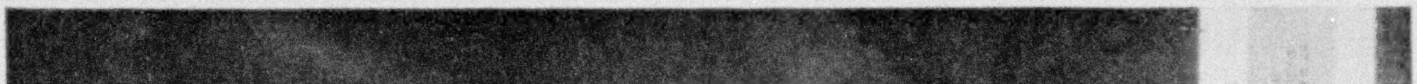


Photograph by D. E. Ford

MR. HASBROUCK AND THE SKULLS AND MUMMIES FOUND NEAR THE RUINS OF PAUCARCANCHA; NOTE TREPANNED SKULL ON BOX



Photograph by Hiram Bingham

THE MOST REMARKABLE TREPANNED SKULL YET FOUND IN PERU

Having five holes, the edges of which show evidence of healing. We are sure that this patient survived his operation (see page 455).

decidedly undershot, and the head, with its short, cropped ears and broad muzzle, has a strikingly bulldog appearance. The legs are well developed and rather heavy, enabling the animal to move fairly rapidly on the ground, in which situation it is by no means a shuffling, helpless creature like many other bats. If molested when thrown to the ground, it will turn and bite savagely.

"The teeth are a highly modified cutting apparatus for making incisions in the skins of mammals and birds. The cheek teeth, or grinders, have their crowns modified into narrow and high-cutting edges which work against their fellows of the opposite jaw much as the blades of scissors.

POWER TO EAT SOLID FOOD LOST

"Some four teeth only on each side take part in this cutting function, all the other molar teeth being suppressed or actually lost. Possessing teeth of a strictly cutting nature, this bat cannot crush insects, so that it is now actually forced to feed on the blood of other animals. Moreover, the gullet is so restricted or narrow that only blood can be passed through it, and the stomach is weak walled, with the general appearance of an intestinal structure. I have on several occasions examined the stomachs of these bats and have found them to contain only coagulated or clotted blood.

"In size the vampire is somewhat larger than our own common brown bat, compared with which it is a much heavier-built animal. The spread between the tips of the outstretched wings is eight or ten inches, and the length of the body from the tip of the snout to the insertion of the hind limbs is three and one-half inches. In habits they are sociable, and are commonly found living in caves or tunnels, suspended from the ceiling in clusters often of immense size.

"The animals usually attacked by the vampire bat are cattle, horses, mules, and donkeys. Their flight is low and close to the surface of the earth, and doubtless takes place late in the evening, when complete darkness has set in; so that they are, owing to such habits, seldom seen.

"Machu Picchu is locally notorious for the poisonous serpents inhabiting the region in which the ruins are situated. During the work of excavation by the 1912 Expedition several species of the dangerous viper commonly known as the *fer-de-lance*, or *bushmaster*, were encountered. During my trip to the ruins in October another smaller species of viper was secured on the trail. The local Indian guide informed me that during the summer he killed on an average one viper a week.

"The venom of the bushmaster is more powerful than that of any other viper in the New World and is slightly different in quality from that of the rattlesnake, to which it is allied in the general structure of its poison apparatus.

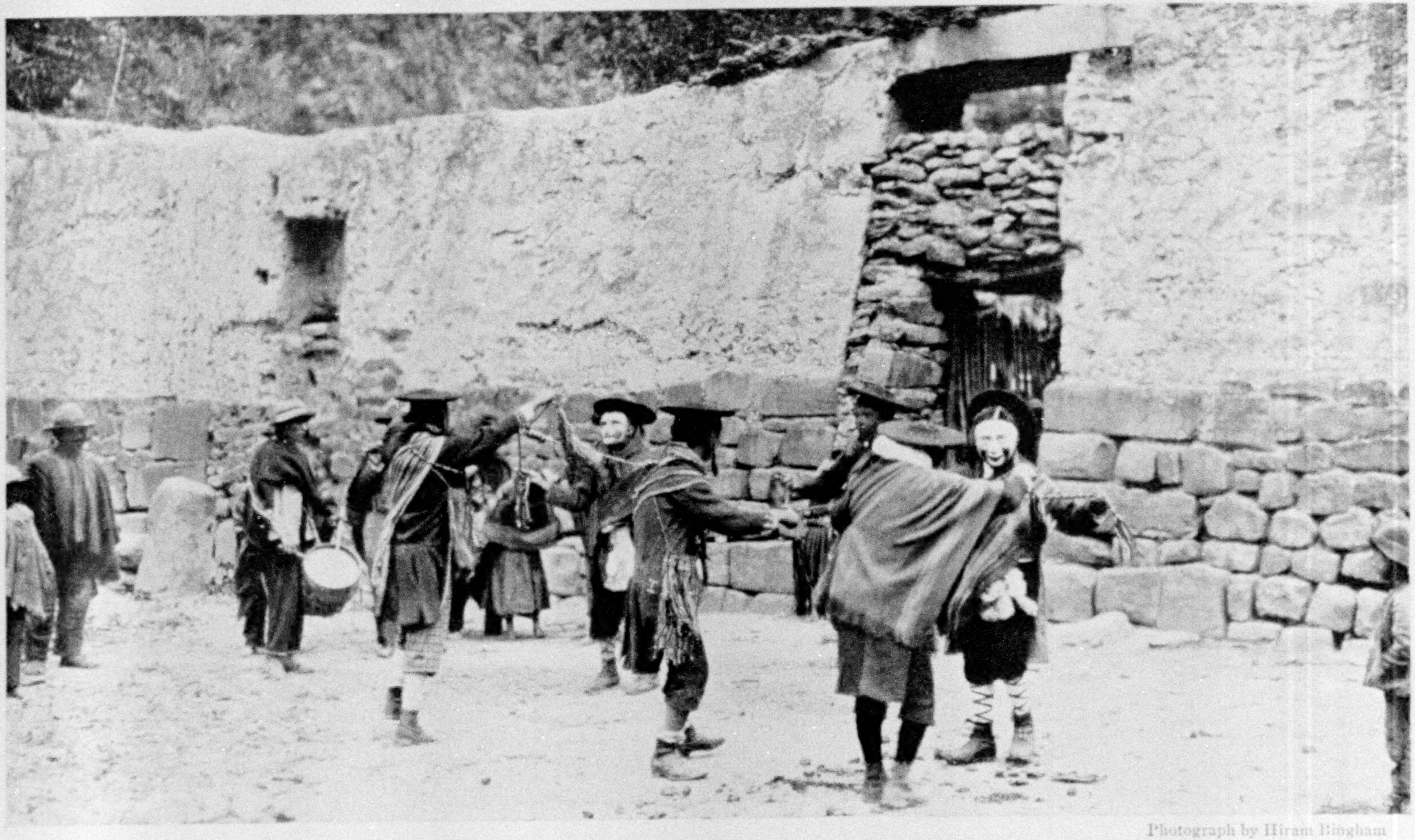
"A much more poisonous reptile, and one found in the same region, is the coral snake, which is armed with venom of the same character as the deadly cobras of Africa and India.

"The city of Machu Picchu is today, as regards its fauna, in much the same condition as during the days of its occupation by the Incas. The commonest birds about the terraces are the crested sparrow, black-headed grosbeak, the goldfinch, gray dove, and brown robin. Condors were seen quite often on the ridge."

The mammals of the ridge are forest types which still manage to live there under the changed conditions. As the city is surrounded by forests for many leagues, it has not been possible for highland mammals of the Andean grass region to reach the ridge by way of any grass-covered tongues or connecting spaces. The mammals known to occur within the limits of the city are the black forest opossum, the spectacled bear, the white-tailed deer, the proboscis-nosed skunk, the brown weasel, a large rodent the size of a woodchuck, a large arboreal or tree rat of the rice-rat group, a rat-like rodent, *Apodon*, and several other smaller rodents.

A WILDERNESS SUPREME

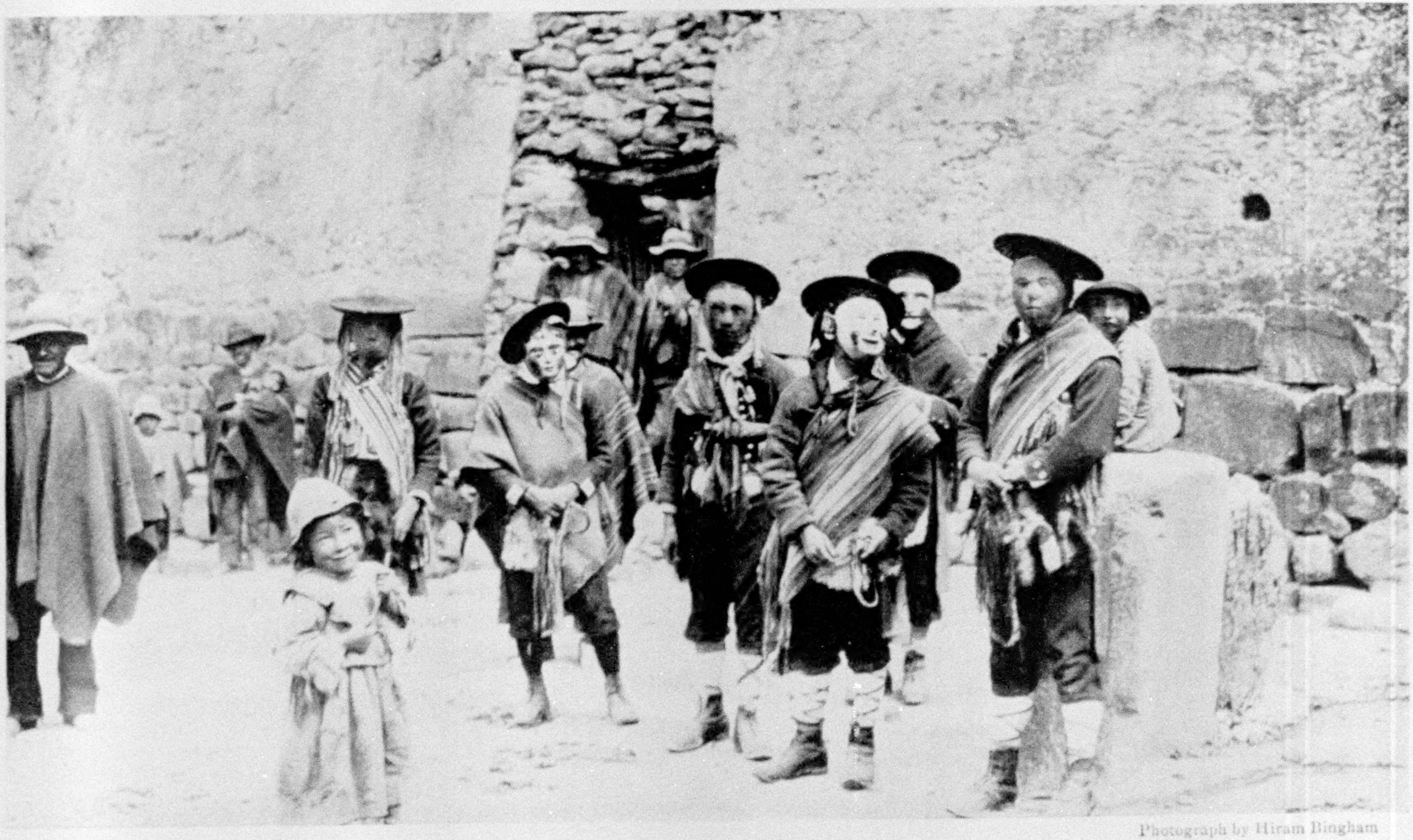
In August a party was organized to explore the so-called San Miguel Valley, which, although occupied for some time by rubber-gatherers, did not exist on any published map of Peru. The party consisted of Naturalist Heller, Topographer Maynard, and Surgeon Ford.



Photograph by Hiram Bingham

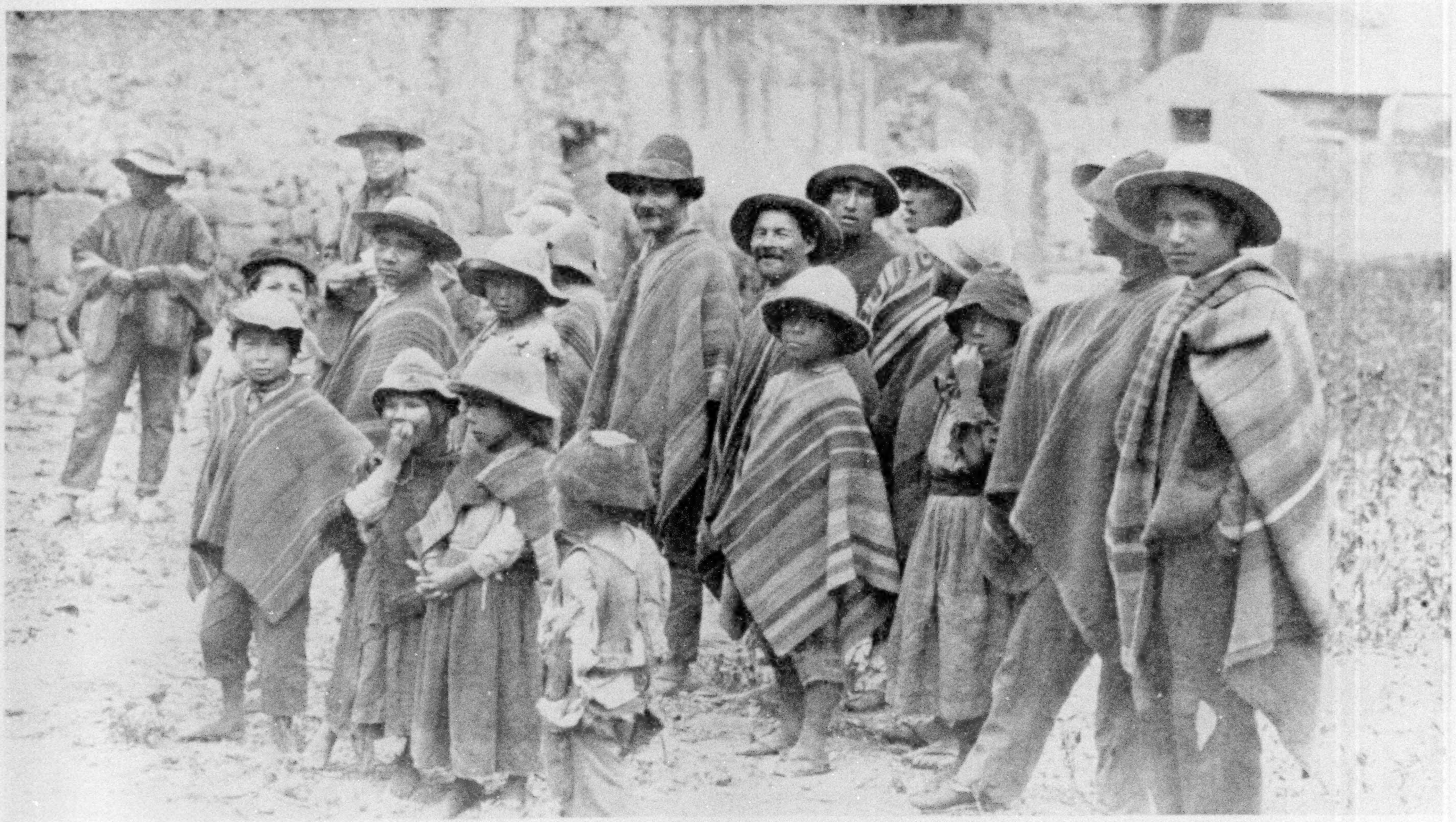
INDIANS DANCING IN THE OLD INCA PLAZA AT OLLANTAYTAMBO

This group was composed of six men dressed as usual, except that they wore black shoes, white stockings, colored paper streamers attached to their clothing, and hideous masks on their faces. Their dance, performed to music furnished by a flute and bass and snare drums, was a shuffle. At its close one of them pretended to be dead.



Photograph by Hiram Bingham

INDIANS ABOUT TO COMMENCE ANOTHER DANCE: OLLANTAYTAMBO



Photograph by Hiram Bingham

PART OF THE AUDIENCE THAT ENJOYED THE DANCING ON THE PLAZA AT OLLANTAYTAMBO

After ascending the steep northern slope of the Vilcabamba Valley, the trail continued from the summit down gentle, grassy slopes, encountering the forest again at 11,000 feet.

"From some of the forest openings," writes Naturalist Heller, "we obtained views of the great forest about us. It was a wilderness supreme, from which not even the thin columns of smoke of the camp-fires of savages could be seen. Nowhere else have I ever met with a region showing such little evidence of the presence of man. Finally, the road turned from the ridge and dropped down a steep grade for a league or more to the San Miguel River.

"The next day we came to the meeting point of the San Miguel and the Pampaconas. These two large streams form the Cosireni River, along which we continued to Yuveni."

"Our journey from Yuveni to the junction of the Cosireni with the Urubamba", write Messrs. Maynard and Ford, "took three days. The porters were rather a poor lot, full of malaria, and about two-thirds of them suffering from Oriental sore.

VICIOUS ANTS

"Two varieties of ants annoyed us considerably. The bite of the one—a small red ant—was not serious. One of our guides, bitten in the foot by the other species, suffered intense pain for a number of hours. Not only did his foot give him great pain, but also his leg and hip.

"On our trip three Indians spent one whole night fishing, and had one fish resembling a perch, and weighing about four pounds, to show for their work. All these Indians are inveterate coca chewers. Tobacco leaves are burned and the ashes placed in a gourd, where they are mixed with water until a pasty mass is formed. This mixture is dipped with a stick tipped with cotton, in much the same way that snuff is sometimes taken.

"Two beverages are made, one from yuccas and the other from honey. The first of these I saw being prepared and did not try it. The second, which is called 'milk of flies', I tried and found delicious. A large hairless caterpillar forms another article of the Indians' diet."

Naturalist Heller learned that the best hunting was to be found two days' march further on, in the valley of the Comberciato. Of his experience on this unexplored stream Mr. Heller writes, in part:

"In volume the river is twice that of the Cosireni. On its banks lived several families of Machiganga savages in small open huts. They gathered the rubber sap, which they traded for salt, knives, cloth, etc., as they have no conception of the use of coins and are quite out of touch with the Peruvian civilization of the highlands (see page 472).

MONKEY MEAT A FAVORITE DISH

"The men are keen hunters and fishermen. Their weapons consist of a black, ebony-like bow, made from the outer wood of one of the small, prickly-stemmed palms, and long reed arrows, which have the feathers at the base arranged in a spiral, so as to give a spiral twist to the projectile and greater accuracy to the weapon. Many are also armed with shot-guns, of an ancient, muzzle-loading type, with very long barrels and of small caliber. With these arms they hunt monkeys chiefly, of whose flesh they are very fond.

"Game birds of large size were abundant. In size and color the *tinamou* resembles the common guinea-hen. Its note was a clear, mellow whistle, one of the pleasantest and most characteristic sounds of the forest during the early morning, and again at dusk. Several species of large turkey-like birds, known as *curra-sows*, were often met. One of these was a heavy, glossy-black bird the size of our turkey, with a high, coral-red bill. On several occasions we saw it about the huts of the savages, thoroughly domesticated and at liberty.

"Parrots of many species were seen. Giant macaws were numerous and paroquettes abundant. A yellow-winged parrot, with remarkable ability as a linguist, was seen in a few localities.

"All of these species were seen domesticated or as pets about the huts of the Machigangas, who were very fond of the society of wild animals and showed

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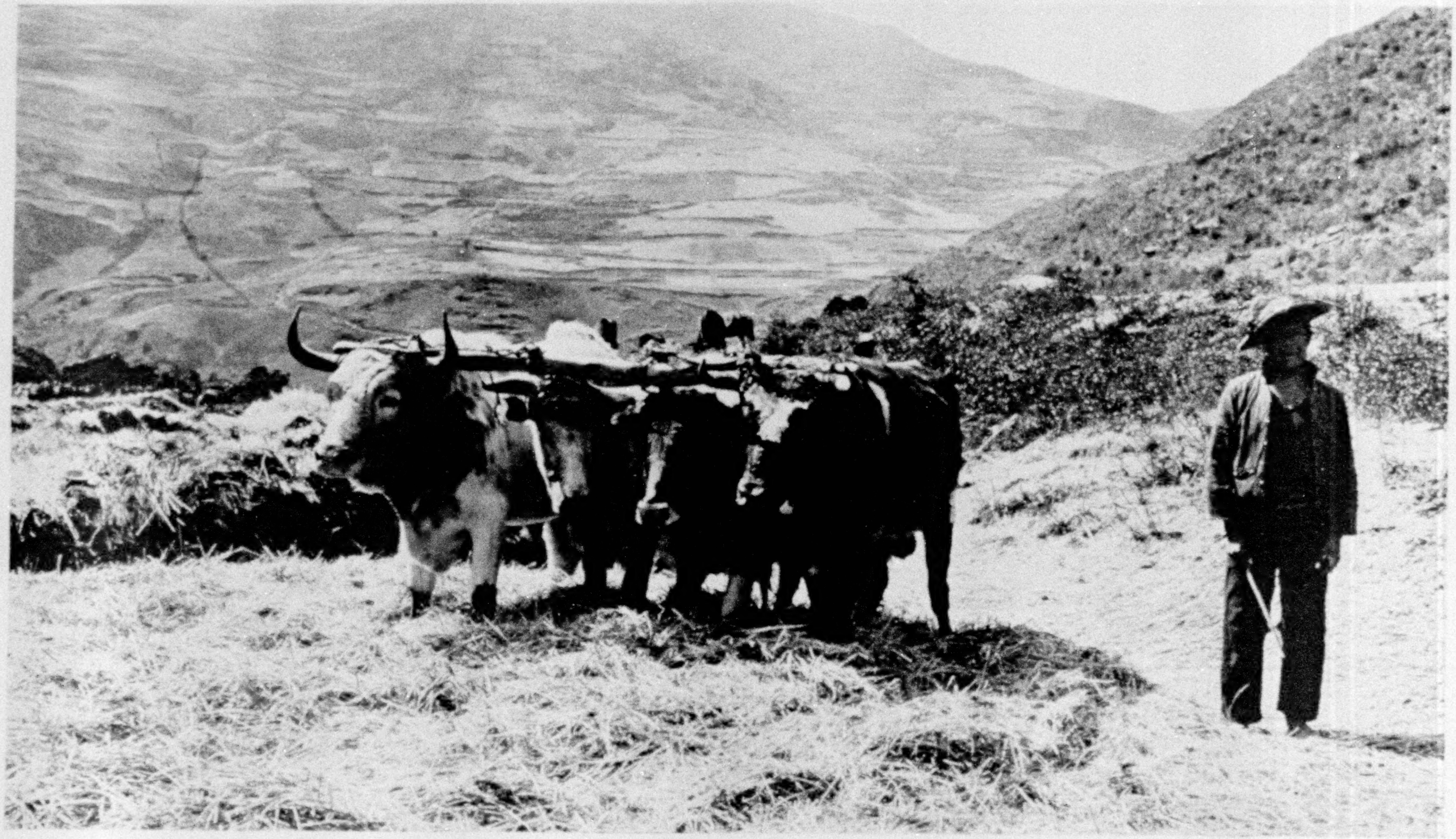


Photograph by E. A. Meserve

AN OPEN-AIR THRESHING FLOOR NEAR HUAROCONDO, PERU

The Biblical injunction against the muzzling of the ox used in treading out the grain on the threshing floor seems to be followed in the letter among the Indians of the Inca country. But their custom of hitching three or four oxen together with head yokes leaves them powerless to eat except under what is known in legislative parlance as "unanimous consent."

much affection for them. They were exceedingly gentle with their pets and were never seen to strike them or to show anger at any misbehavior on their part.

"Considerable hunting was done at night with a reflecting lantern of high power. These nocturnal rambles yielded specimens of red deer, several species of night-prowling carnivorous animals, opossums, and a peculiar night snake of the genus *boa*. The eyes of this snake were quite luminous and could be detected at a distance of 20 yards or more. The body was distinctly compressed, like that of a fish, instead of being circular in outline. The head was large and arrow-shaped, and armed with long teeth in the upper jaw, giving it a close resemblance to such poisonous snakes as vipers. The snake was light gray, resembling the bark of many forest trees; but on the back it was marked by large diamond blotches of a brown color.

"The largest specimen obtained, some 6½ feet long, was shot at 10 o'clock one night, hanging with its head within a foot of the ground and close to a small spring of water in the forest, which was a favorite resort for small mammals and other animals. This snake, after being rendered harmless by a shot in the head, coiled its body about the barrel of my shot-gun and exhibited such powers of constriction that it could scarcely be pulled loose again.

"Some 30 specimens of monkeys were collected, representing six different genera, with a single species to each. Besides the monkeys, two species of rare carnivorous mammals were obtained."

The complete zoölogical collection consists of 891 specimens of mammals, representing some 80 species, and 695 specimens of birds, representing some 400 species, besides several tanks filled with reptiles and batrachians. Of snakes there are some 15 or 20 species, of which 5 are vipers. There are 100 or 200 specimens of fishes, most of them of small size.

RICH IN FOODS

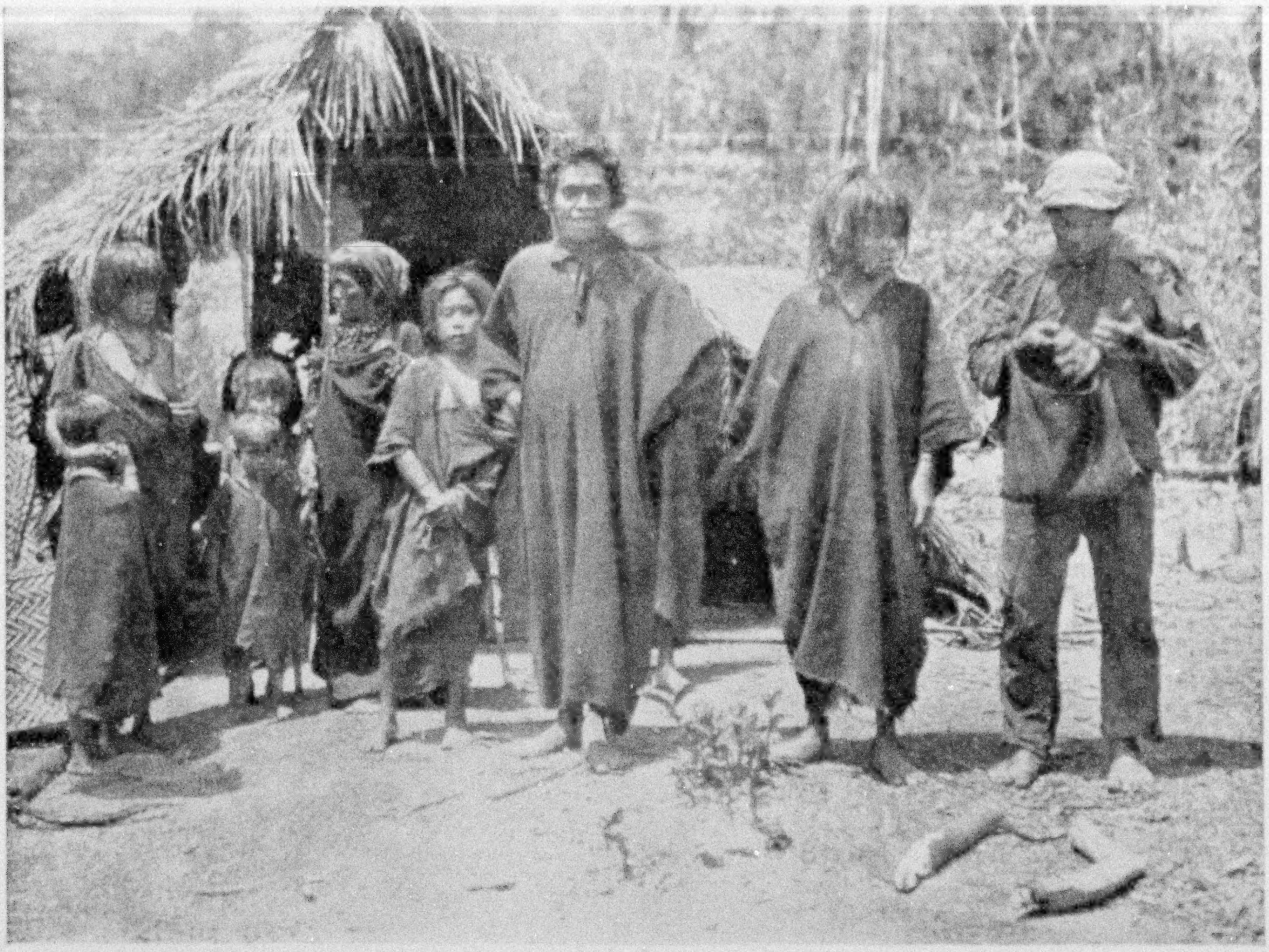
The botanists spent three weeks in the canyon near Machu Picchu and found the region particularly interesting, because it represented the border line between tropical crops and those of the temperate zone. The people of Machu Picchu, by going down the valley, could raise well-known tropical fruits like alligator pears, custard apples, guavas and papayas, and tree tomatoes. At the present time coffee, cocoa, bananas, sugarcane, oranges, limes, and lemons can be grown in the valley not far below Machu Picchu. Whether any of these last-named vegetables were known to the Incas is very doubtful. On the other hand, they did grow in these tropical valleys cotton and coca, from which we derive the extract cocaine.

By going up the valley a few miles on the other side, such temperate-zone plants as potatoes in large variety, many kinds of Indian corn, and a considerable number of food plants that have not as yet been domesticated in the United States, could be grown in profusion.

Although Machu Picchu is thus shown to have been remarkably well situated strategically from the food point of view, the builders were greatly handicapped by the small amount of flat, arable land. As a result, they built terraces everywhere, and the extent to which they carried the construction of these small garden plots is even more extraordinary than we at first supposed it to be. Mr. Cook says in his report that "every spot where plants could be made to grow appears to have been utilized" (see the original paper by Professor Cook beginning on p. 474).

MODERN INDIANS OF THE LAND OF THE INCAS

Studies of the modern Indians, particularly in the Department of Cuzco, were made by Surgeon Ford and Chief Assistant Hardy. While Dr. Ford had to deal chiefly with Indians who came to consult him on account of their health, he made it a point to take measurements of as many subjects as were willing to submit to the "white man's medicine" of measuring-tape, calipers, and camera. Mr. Hardy gave his special attention to the general subject of the manners and customs of this region. Owing to the necessary limitation of space, I can only quote from a few paragraphs of their reports.



Photograph by Edmund Heller

THE MACHIGANGA INDIANS: PERU

These Indians gather rubber sap which they exchange for salt, knives, cloth, etc. They have no conception of the use of coins. Their weapons consist of bows and arrows and antiquated muzzle-loading shot-guns. They are very fond of monkey meat (see page 469).

"Anthropological measurements and observations were made by the Hrdlicka method. This necessitates approximately fifty notations and two photographs. Furthermore, it has the advantage of requiring but little removal of clothing and consequent exposure of person.

"As in former expeditions, the Quichuas were found to be very difficult to handle. They have an instinctive fear of the camera and a deep suspicion of the foreigner. Those living far from the main trails, who come little in contact with strangers, can seldom be persuaded to pose for portraits. They cannot be bribed or bought. They have little desire for money. They will not argue the question; simply turn their backs or run. There is a belief among them that the camera sees through their clothing and takes them in the nude.

"Along the more frequented lines of travel and in the small towns, especially after a few days of association, or by gaining their confidence through medical treatment, I could persuade many to pose for their portraits. Interest in their ailments and sympathy for their troubles would buy almost anything, from anthropological measurements to mule feed. By these methods and the occasional use of empty tin cans, cracker-boxes, and small silver coins, 153 Quichuas were measured—90 men and 63 women—and nearly as many photographed.

"The men were keen in the use of the dynamometer, the interpreter having explained that the one who put the needle the highest was the best man."

Southern Peru may be divided into three zones, based on altitude. These are: first, the highlands, the country devoted to grazing and potato-raising, 12,000 feet or more in altitude; second, the cereal belt, between 7,000 and 12,000 feet in altitude; and, third, the belt of tropical agriculture, which is below 7,000 feet in altitude.

"The occupations of the highland Indian are stockherding and potato raising." Writes Mr. Hardy, "the stock belongs to the owner of the finca, but the Indian is allowed to pasture his own sheep and cattle with the rest. These are not many, although I found one Indian who claimed to own forty sheep, fifteen cows, and two pigs. He paid ten soles, or $4.80 gold, a year rental and had to work one week each year for the finca owner. They move as lack of pasture may demand, but always to some spot as wild and desolate as that from which they came.

AN HONEST RACE

"The Indians of the highlands have the purest blood and are much more attractive than those of the montaña or slopes. Bronze skinned, of medium height, but with huge chest expansion and wonderful leg development, some of the men of the highlands present a striking appearance. Those of the lowlands, although lighter in color, are generally more ill-favored and lack the ruggedness of feature possessed by those of purer blood. They are smaller, less healthy, and show more marks of dissipation. The pure-blooded women are rarely attractive, yet in Urubamba they are more attractive than the men and have more regular features. Practically all the natives have dark hair and eyes.

"In the uplands both men and women keep to their old styles of clothes, but as one goes down modern styles appear, until in the tropical belt the stiff, broad-brimmed hat and hand-woven poncho have disappeared entirely. Skirts get higher along with the altitude, until at some places they scarcely reach the knee, and give a decidedly fashionable effect.

"In the highlands the woman's hat closely resembles the man's (usually a bit smaller in circumference), but she never wears the woolen skull-cap. To match the poncho she has a *lliclla*, or shawl, the upper corners fastened in front with a silver pin or topo, usually possessing the shape of the bowl of a soup spoon.

"I found the Indians quite honest. Only two or three small articles were lost during the construction of our house at Yankihausi. It was the custom to pay their wages in advance, and we never met with very much disposition on their part to fail us.

"The Indians' only pleasures are beastly carousals. The children have no toys and are almost never engaged in play. As soon as they are able to walk they are set to work. They are early taught to collect firewood and forage wherever they can. Several times in Ollantaytambo I saw a little girl, who could not have been over three years old, driving home a sheep loaded with small branches which the child had collected for firewood."

The result of our four expeditions leads me to conclude that the Peruvian Indian is worth study and development. While it must be admitted that they seldom bathe and have some filthy habits, this is partly the result of living in the cold of the Andes and partly due to ignorance.

If the government of Peru would follow the example of the United States government in making it a crime to sell alcohol and cocaine to the Indians, its revenue would be greatly curtailed; but there is no question that ultimately the country and the Indians would both be far better off.

XUM

STAIRCASE FARMS OF THE ANCIENTS

Astounding Farming Skill of Ancient Peruvians, Who Were Among the Most Industrious and Highly Organized People in History

By O. F. Cook

Botanist of the National Geographic Society–Yale University Expedition
to Peru in 1915, and of the Bureau of Plant Industry
of the Department of Agriculture

AGRICULTURE is not a lost art, but must be reckoned as one of those that reached a high development in the remote past and afterward declined, and has not yet recovered its ancient prestige. The system of agriculture developed by the ancient Peruvians enabled them to support large populations in places where modern farmers would be helpless.

The most specialized development of agriculture in the Western Hemisphere was attained, unquestionably, in Peru, and the culmination was reached centuries ago, before Columbus discovered America. Still farther back there must have been a period of slow and gradual development—a period to be expressed in millenniums rather than in centuries. *At a time when our ancestors in northern Europe were still utter savages, clothed only in skins, and living by hunting and fishing, settled agricultural communities must have existed in the Peruvian region*, perhaps in the same valleys that contain the marvelous remnants of the prehistoric art.

The people who did the finest of the ancient work are not only gone and forgotten, but lack even the distinction of a name. Written records like those of Egypt and Assyria are lacking in Peru, and even tradition has failed to attach names of kings or nations to many of the ancient monuments. Some writers refer to the builders as Megalithic or Big-Stone people, because they used very large stones, like the fabled Cyclopes of the ancient Greeks, who built massive walls and worked in metals. Other writers refer to the ancient Peruvians simply as pre-Incas, because their work evidently belongs to an age farther back than the Inca empire conquered by the Spaniards.

As a race, it may be assumed that the Megalithic people were ancestors of the modern Quichuas, or at least of the same stock, for there is nothing to show that the human type was different in ancient times. In Peru, as in ancient Egypt, it was the custom to mummify the dead and to bury with the mummies the clothing, food, household utensils, weapons, and other objects and articles used by the living.

This regard of the ancients for their dead, together with the dry, equable climate, have made Peru a veritable treasure-house of archæological material. Not only the skeletons and the other physical features of the ancient people are known, but also the nature and degree of development of all of the arts that could be preserved by burial. The general result of such studies tends to show that the modern Quichuas, the Incas conquered by the Spaniards, and the pre-Inca or Megalithic people were all of the same race and practiced the same arts, including the art of agriculture.

The Incas had a very specialized agriculture, but their predecessors had some of the agricultural arts still more highly developed. They built larger terraces and faced them with larger stones, fitted with wonderful accuracy. The Incas also built extensively, but generally with less skill, or at least with less labor, bedding their stones and plastering their walls with clay, instead of taking the trouble to work down and fit together the huge irregular blocks that characterize the Megalithic period.

Like Egypt in the later dynasties, the Peruvians of the Inca age appear to have declined somewhat from the standard of industry, patience, and perfection indicated by the stone work of the earlier period. In other respects progress may have been made. Thus the Incas may have been better organized and more efficient from the standpoint of government and military activity, as were the Romans in comparison with the Greeks. The modern Quichuas are still an agricultural and pastoral people, but they show no tendency to imitate the constructive undertakings of their predecessors.

STAGES OF AGRICULTURAL PROGRESS

In order to appreciate the high development of the ancient agriculture of Peru, we have to consider briefly the stages that mark the progress of agriculture from the simplest beginnings to the most advanced expression of the art.

In the most primitive form of agriculture, still widely practiced in the tropics, the land is not permanently or continuously occupied. New clearings are made every season by cutting and burning. Corn is planted and harvested, and then the forest growth is allowed to spring up again. This nomadic system of annual cornfields, or *milpas,* as they are called in Central America, is practiced in all tropical countries of low elevation.

Tillage agriculture is the next stage. In order to use land for more than one season, tillage is necessary, at least to the extent of stirring the surface soil and destroying weeds, so that seeds can be planted.

A third stage is reached when tillage agriculture is improved by the application of manure, fish or seaweeds, or by using decayed vegetable matter or "green manure" to increase the fertility of the soil. Another step beyond tillage, with or without the use of fertilizers, is irrigation—the artificial application of water to the soil. Irrigation must have begun in regions where it was easy to supplement the natural rainfall by diverting streams, as in the steep mountain valleys of Peru.

Doubtless all of the preceding forms of agriculture were represented in Peru in ancient times, as they are at the present day; but they must have had relatively little importance in comparison with a type still more advanced—a type quite unknown to the American farmer and scarcely to be seen in the United States, except to a very slight extent in ornamental grounds. This most specialized type of agriculture includes all of the preceding features — tillage, fertilizing, and watering the crops; but another is added—the artificial construction of the soil on which the crops are grown. *In the valleys where the ancient Peruvian agriculture was centered, most of the agricultural land is not natural soil, but has been assembled and put in place artificially* (see also page 494).

MARVELOUS TERRACE AGRICULTURE

This most specialized type may be described as terrace agriculture, and is seen in its most conspicuous form when narrow terraces are built on steep slopes. Such terraces are found in many other countries, though it is doubtful whether any equal those of Peru. In Peru the artificial reconstruction of the soil surface was not limited to the terraced slopes, but was also undertaken in large areas of reclaimed land in the bottoms of the valleys. The courses of the rivers were narrowed and straightened by strong walls, and then the land behind the walls was filled in, and finally a surface layer of fine agricultural soil was put on.

The entire region that represents the chief center of the Inca empire and its Megalithic predecessors affords very little of the level or gently sloping natural soil that we would consider well suited to agriculture. Most of the level land is on the high plateaus, where the climate is too cold or too uncertain for the growth of crops, so that planting is confined largely to the slopes to avoid the danger of frosts in the growing season.

To us in the United States this laborious construction of the artificial lands in the warmer valleys seems almost incredible. Even irrigation agriculture appears to us as a new and very specialized branch of the art, and we think ourselves very enterprising to have undertaken the reclamation of our so-called "deserts" in the Western States, where wide expanses of nearly level and very fertile soil have been made richly productive simply by being supplied with water. The native agriculture of Peru reached the stage of reclamation projects long before America was discovered by Europeans. *Our undertakings sink into insignificance in the face of what this "vanished" race accomplished.*

The narrow floors and steep walls of rocky valleys that would appear utterly worthless and hopeless to our engineers were transformed, literally made over, into fertile lands, and were the homes of teeming populations in the prehistoric days. That the work was well done there can be no possibility of doubt, for many thousands of acres of these artificial lands are still fertile and are the chief support of the modern population of the valleys. The native people take the amazing works of the ancients as a matter of course, as we accept the natural features that surround us, and are no more inclined than we are to such impossible undertakings as the ancient people accomplished.

That the ancient people should have taken to terrace-building is not difficult to understand in the presence of the natural conditions where the art developed. With an agricultural population becoming crowded in steep, rocky valleys, the removal and piling up of the stones to give more room for plants would be a most natural step for a primitive people to take. In the early days the building of terraces may have appeared simply as an effective way of disposing of the stones and leaving the largest area of tillable land after the work was done. If there were more stones than could be used in building the walls, the surplus could be disposed of by placing them behind the walls to form a porous subsoil for the surface layer of fine earth where the crops were grown. More land could be cleared by building the stones into walls than by merely throwing them into piles. The desirability of piling the stones or building the walls so that they would hold the soil in place and prevent washing would also become apparent.

The most strikingly artificial feature of the ancient Peruvian agriculture was the covering of steep slopes with narrow terraces, supported by stone walls and watered by aqueducts built for many miles along the precipitous slopes of the mountains. Some of the terraces, those that characterize the Megalithic Age of Peru, were built of enormous stones, often of very irregular form, fitted together with wonderful nicety.

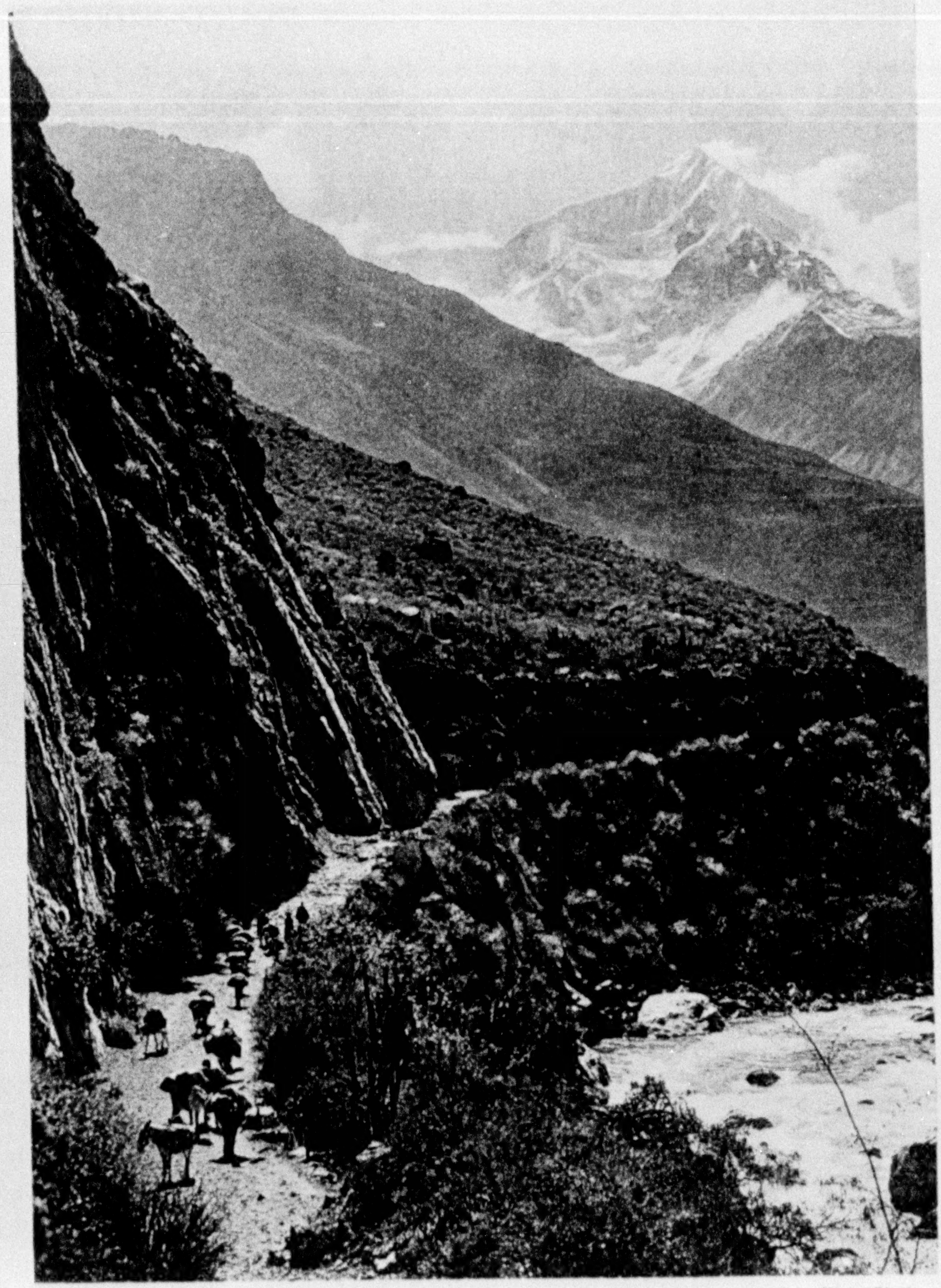
The labor expended in the construction of these terraces shows that they served some purpose that the builders considered very important. We learn from the early Spanish historians that the Incas had special gardens for raising the potatoes of the royal household, and that there was a general belief among the people that the growth of crops and the fecundity of the flocks were acutely dependent upon the welfare of the royal family. Hence there was an underlying practical reason for the deep solicitude of the people, so often remarked by the early historians, "That it might be well with the Inca".

COMPARED TO THE HANGING GARDENS OF PERU, THOSE OF BABYLON WERE INSIGNIFICANT

The hanging gardens of Babylon have long been reckoned as one of the wonders of the Oriental world; and yet they were a mere transient toy and for 3,000 years have been only a tradition. The hanging gardens of Peru, though of unknown antiquity, are still in existence, and doubtless as worthy of our admiration as were those of Babylon in the days of Herodotus and Strabo.

The Babylonian gardens are said to have been 400 feet square and as high as the walls of the city, variously stated at from 75 to 300 feet. The structure had the form of a pyramid, with broad steps, on which earth was placed for the growth of plants. No doubt such an artificial hill was a striking object in the plain of Babylon, and gave Nebuchadnezzar's Median queen a pleasant reminder of her mountain home, where, it may be, there were valleys with terraced slopes as in Peru.

Many banks of terraces in Peru are very much longer and very much higher



Photograph by Hiram Bingham

MT. VERONICA, 20,000 FEET HIGH, THE URUBAMBA RIVER, AND THE MAIN VALLEY ROAD

A portion of the pack train of the National Geographic Society-Yale University Peruvian Expedition of 1915 in the foreground.

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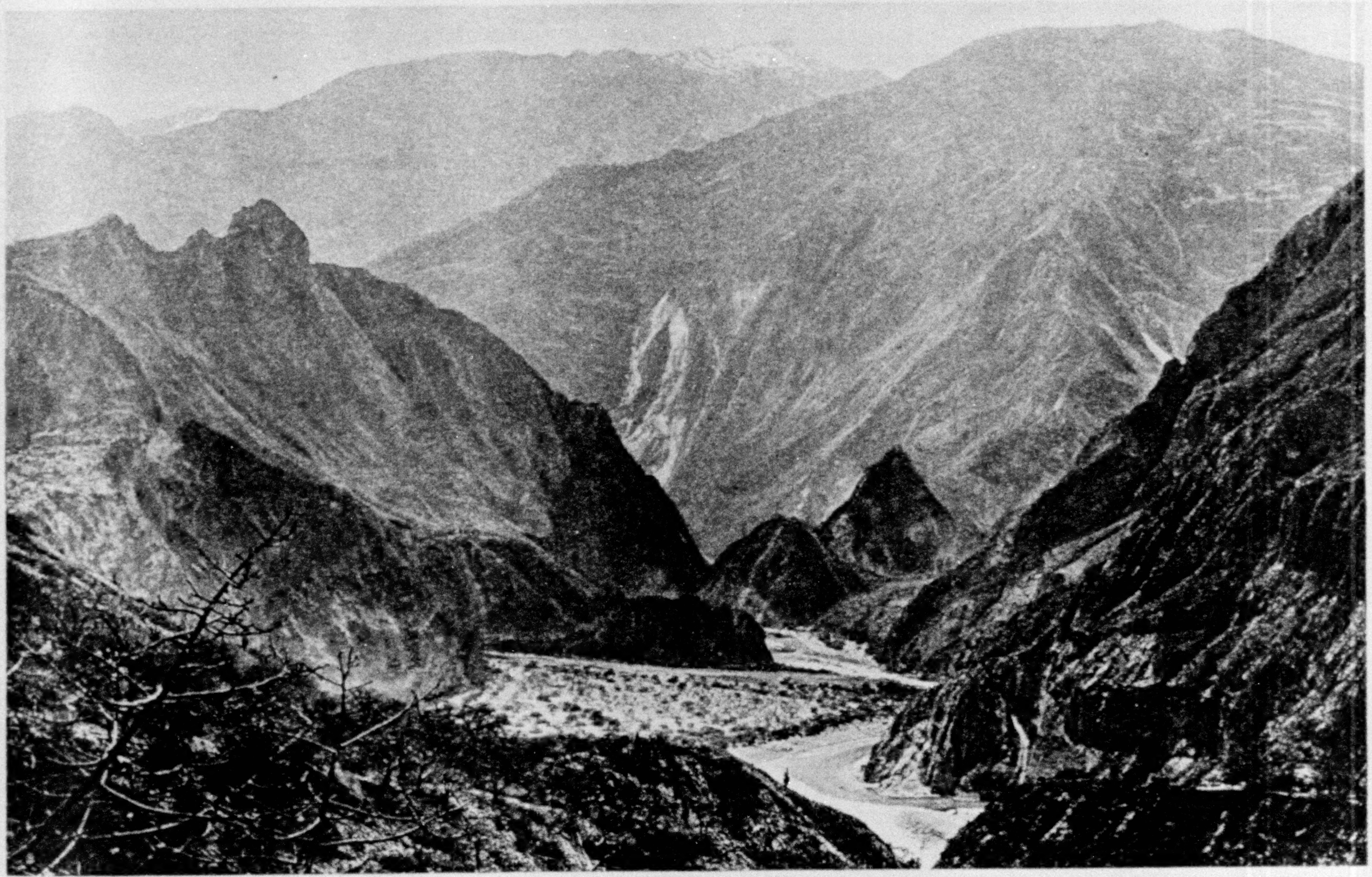
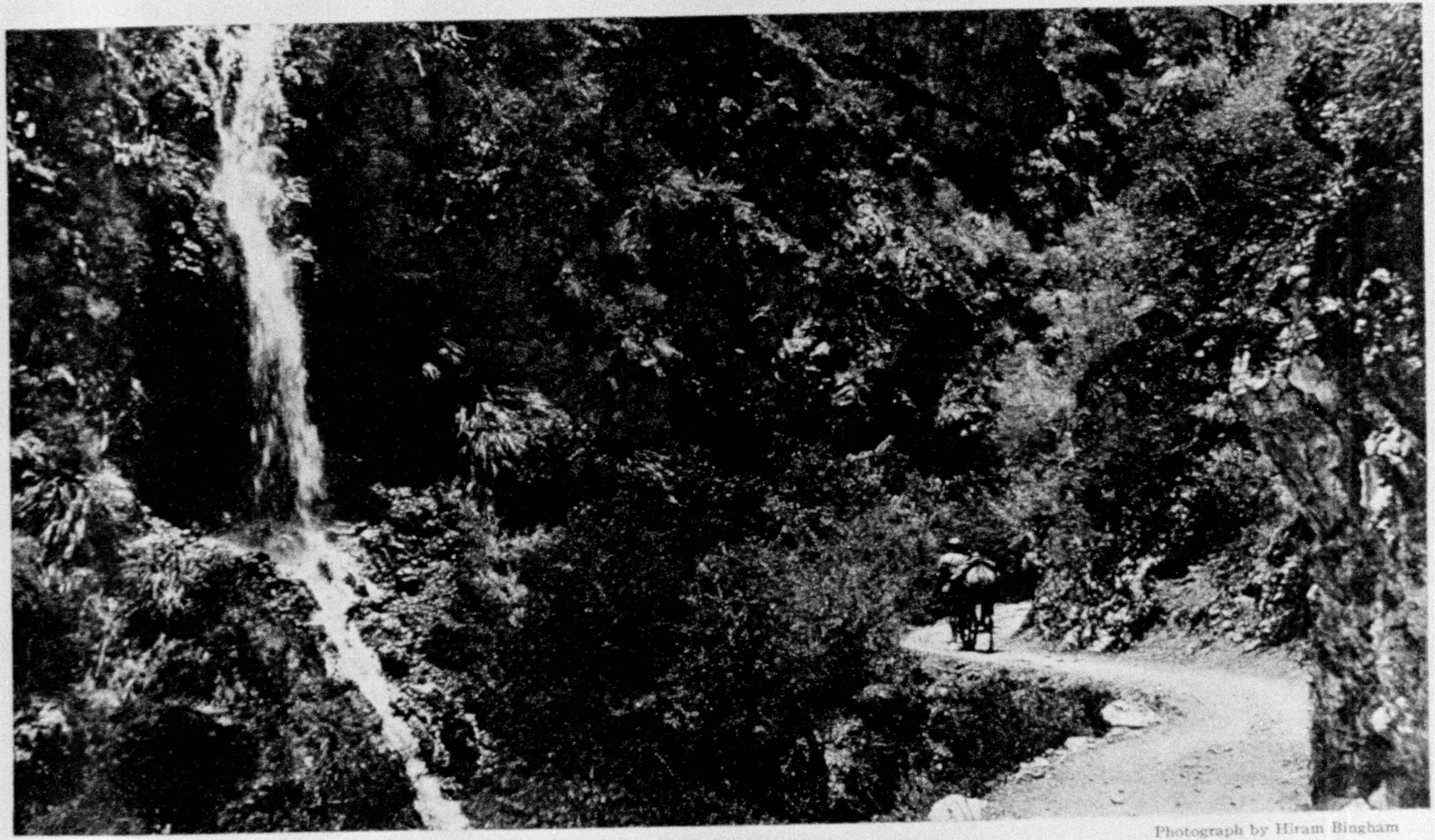


Photograph by Hiram Bingham

THE GRAND CANYON OF THE APURIMAC

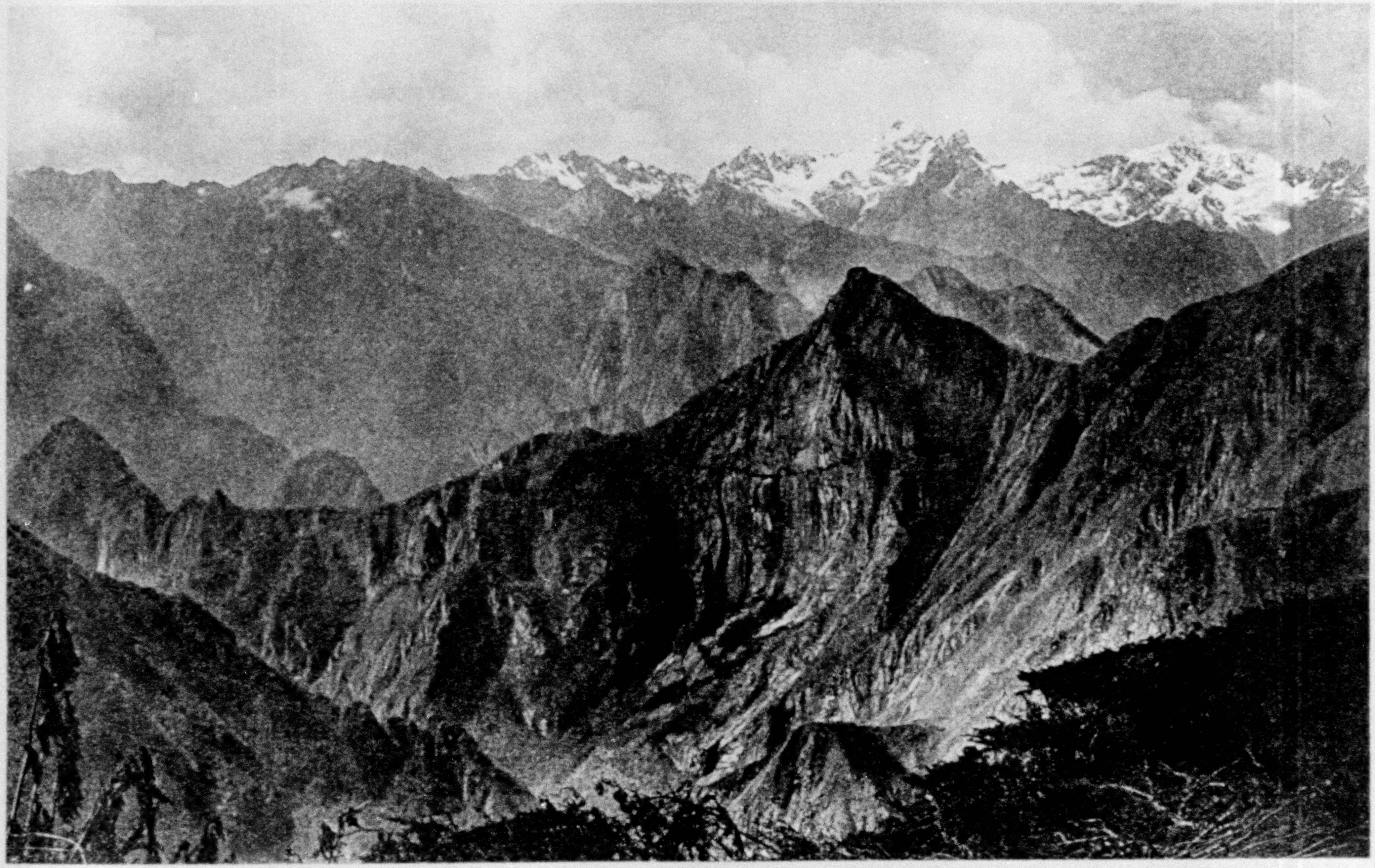
A bit of the Apurimac Valley between La Estrella and Abancay. If the Pan-American Railway is ever completed, one of the most interesting sections and one involving tremendous engineering difficulties will be in this immediate vicinity, where the road from Cuzco to Lima crosses this magnificent tributary of the Amazon.



Photograph by Hiram Bingham

AN ARTIFICIAL WATERFALL CONNECTING TWO ANCIENT IRRIGATION DITCHES IN THE HIGH COASTAL DESERT OF SOUTHWESTERN PERU

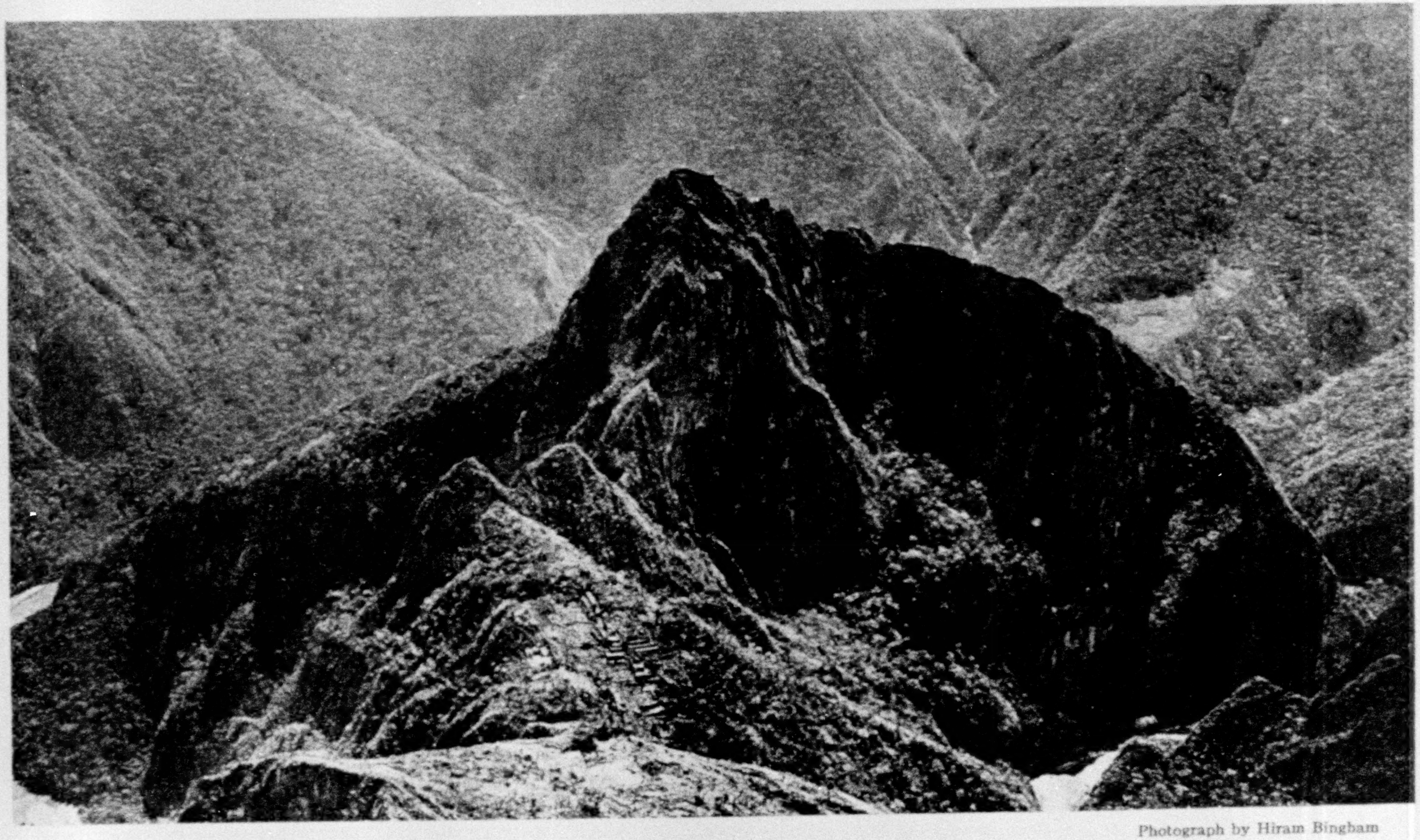
Numerous irrigation channels were carved along the steep mountain slopes, often for long distances. The courses of rivers were straightened, and many square miles of artificial land were constructed in the bottoms of the valleys with an expenditure of labor almost inconceivable.



Photograph by Hiram Bingham

THE NARROW RIDGE ON WHICH MACHU PICCHU IS SITUATED AND THE MAGNIFICENT URUBAMBA CANYON

A distant view of Machu Picchu on its narrow ridge, flanked by precipices, in the most inaccessible corner of the Andes, in the heart of the Urubamba Canyon. The sharp peak in the right foreground is Machu Picchu Mountain. The lower conical peak at the extreme left is Huayna Picchu. The city of Machu Picchu is on top of the ridge between these two peaks and almost directly underneath the little fleecy cloud which hides part of a distant mountain.



Photograph by Hiram Bingham

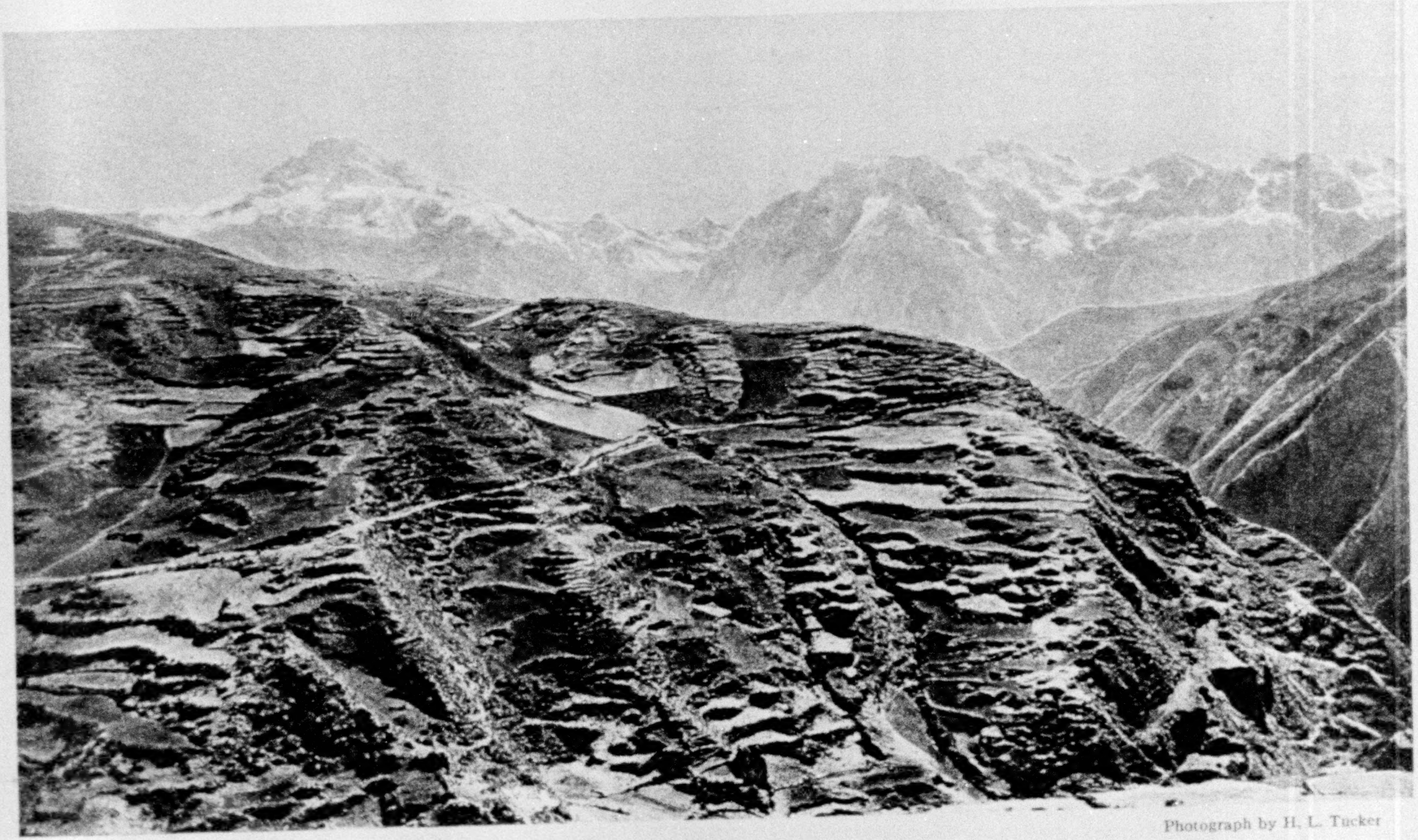
BIRD'S-EYE VIEW OF HUAYNA PICCHU MOUNTAIN AND MACHU PICCHU RUINS BEFORE MUCH CLEARING HAD BEEN DONE BY THE NATIONAL GEOGRAPHIC SOCIETY–YALE UNIVERSITY EXPEDITIONS

Situated on the top of the ridge at the foot of the hill called Huarua, protected on all sides by precipices and on three sides by the Urubamba River, Machu Picchu was ideally located for defense. The mountains in the distance form the side walls of the Grand Canyon of the Urubamba, often nearly a mile and a half deep.

Photograph by Hiram Bingham

THE SWITZERLAND OF PERU: A SCENE IN THE CENTRAL URUBAMBA VALLEY

The people of Pre-Columbian Peru had more than sixty species of plants under general cultivation, with half as many more under local cultivation. No other part of the Americas equaled this record. Peru was the chief center of plant domestication in the New World



Photograph by H. L. Tucker

WHEAT AND BARLEY FIELDS ON THE SLOPES ABOVE THE URUBAMBA VALLEY

Across the middle of the picture runs one of the great highways of the region that has its center in the city of Cuzco.

The culture of the Incas may be said to have resulted largely from their success in domesticating the alpaca and the llama. They were domesticated so long ago that no wild members of the species remain. Using hundreds of thousands of beasts of burden capable of carrying from fifty to one hundred pounds apiece, the Incas were able to carry out their splendid engineering and agricultural work.

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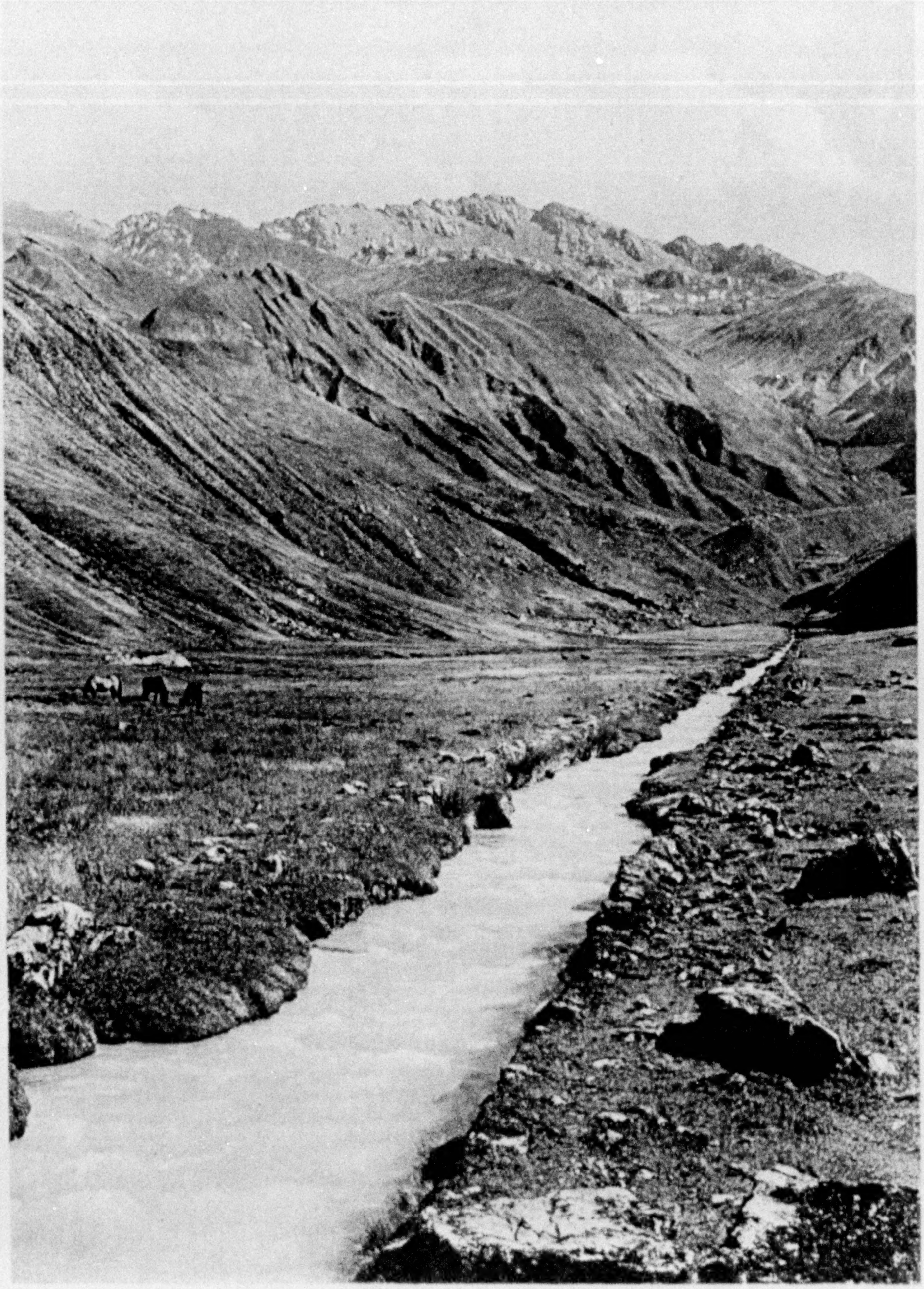

Photograph by Hiram Bingham

ONE OF THE HIGHEST AGRICULTURAL CANALS IN THE WORLD

The rich bottom lands of this elevated valley were desired by the Incas for growing potatoes. Accordingly, the meandering stream was straightened and enclosed so as to prevent it from occupying any more land than was absolutely necessary. It is in the upper valley of the Pampacahuana, a tributary of the Urubamba, and is at an elevation of 12,800 feet. Potatoes are still raised on the slopes of this valley at an elevation of slightly more than 13,000 feet.

Photograph by Hiram Bingham

AN UPLAND VALLEY EXPLORED BY THE NATIONAL GEOGRAPHIC SOCIETY–YALE UNIVERSITY EXPEDITION FOR THE FIRST TIME IN 1915

We are able to get a glimpse of life among the ancient Incas through the part of their vocabulary that has come down to us. They had different expressions to denote all the degrees of drunkenness, which shows that they had no prohibition; the absence of words for buying and selling shows that money was unknown; the fact that they had a single word to denote "enemy" and "soldiers" would indicate that they must have been "peace-at-any-price" people.

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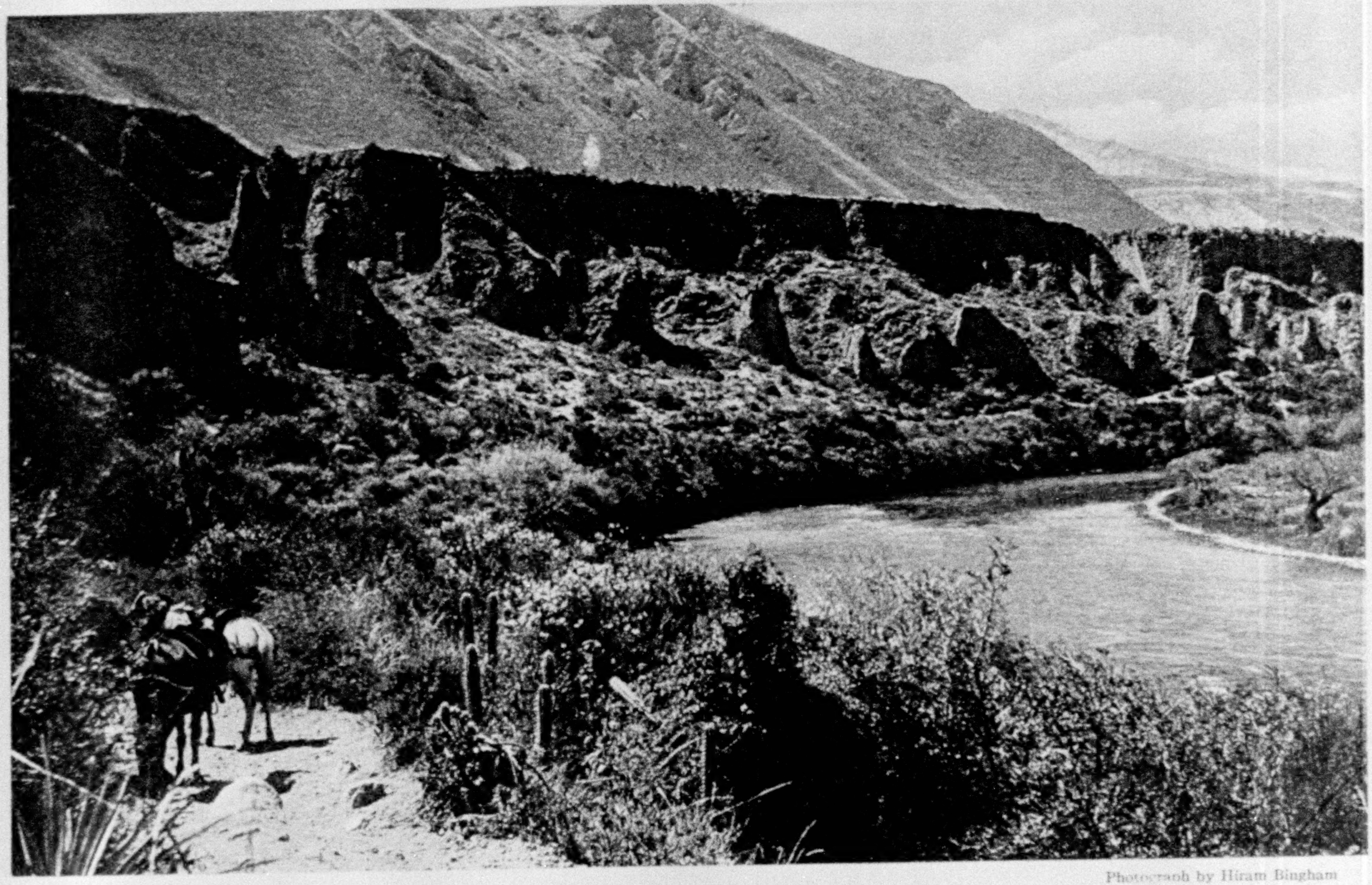
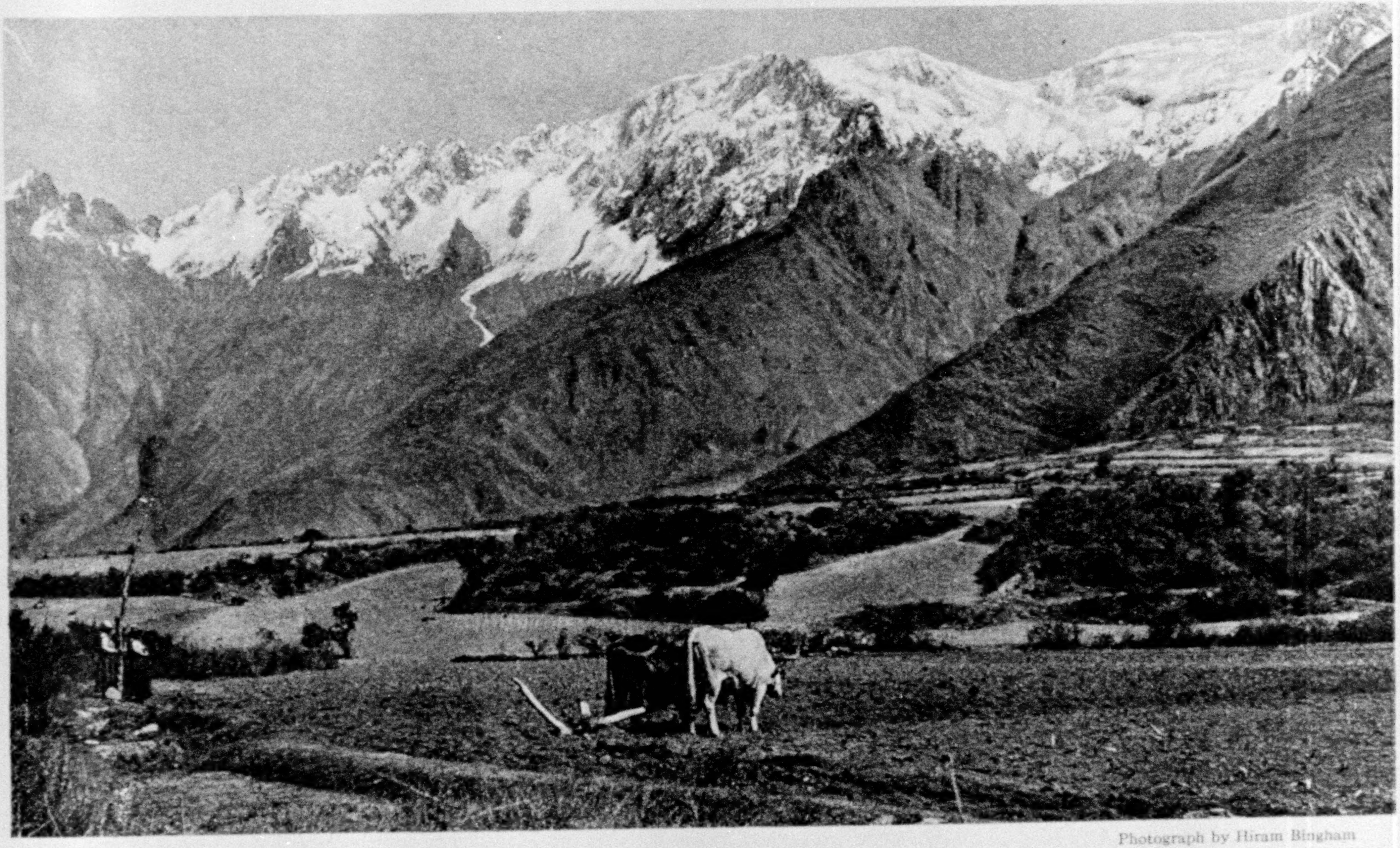


Photograph by Hiram Bingham

A ROADSIDE SCENE IN THE CENTRAL URUBAMBA VALLEY

The rim of this valley is from 6,000 to 10,000 feet above the river, and from 16,000 to 20,000 feet above the level of the sea. In these remote regions a llama can be bought for three dollars, a sheep for thirty cents, and a llama-load of firewood for twenty cents.



Photograph by Hiram Bingham

PLOWING TIME IN PERU

The sons and daughters of the Inca race may still survive, but their blood has outlasted their civilization.

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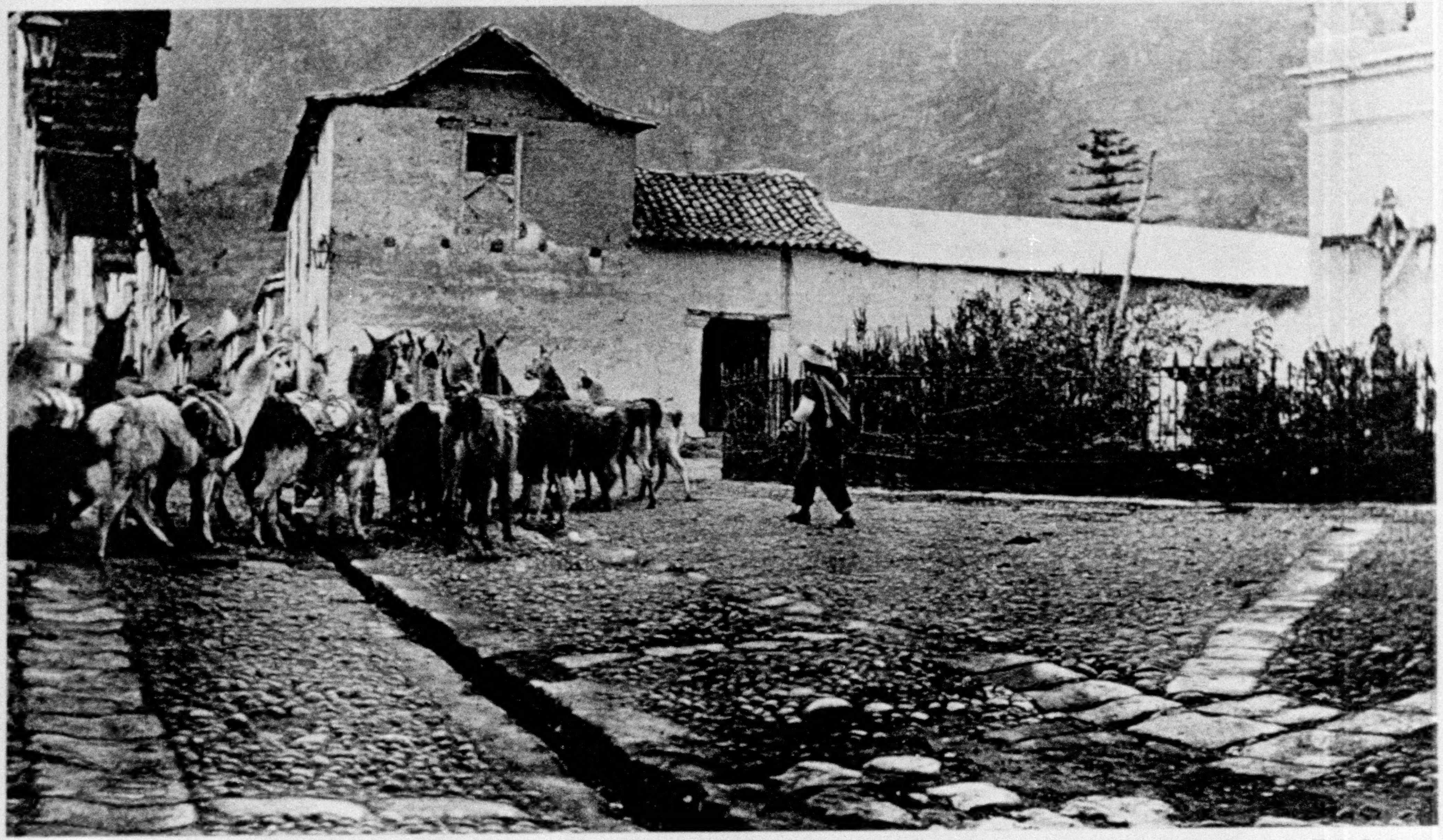
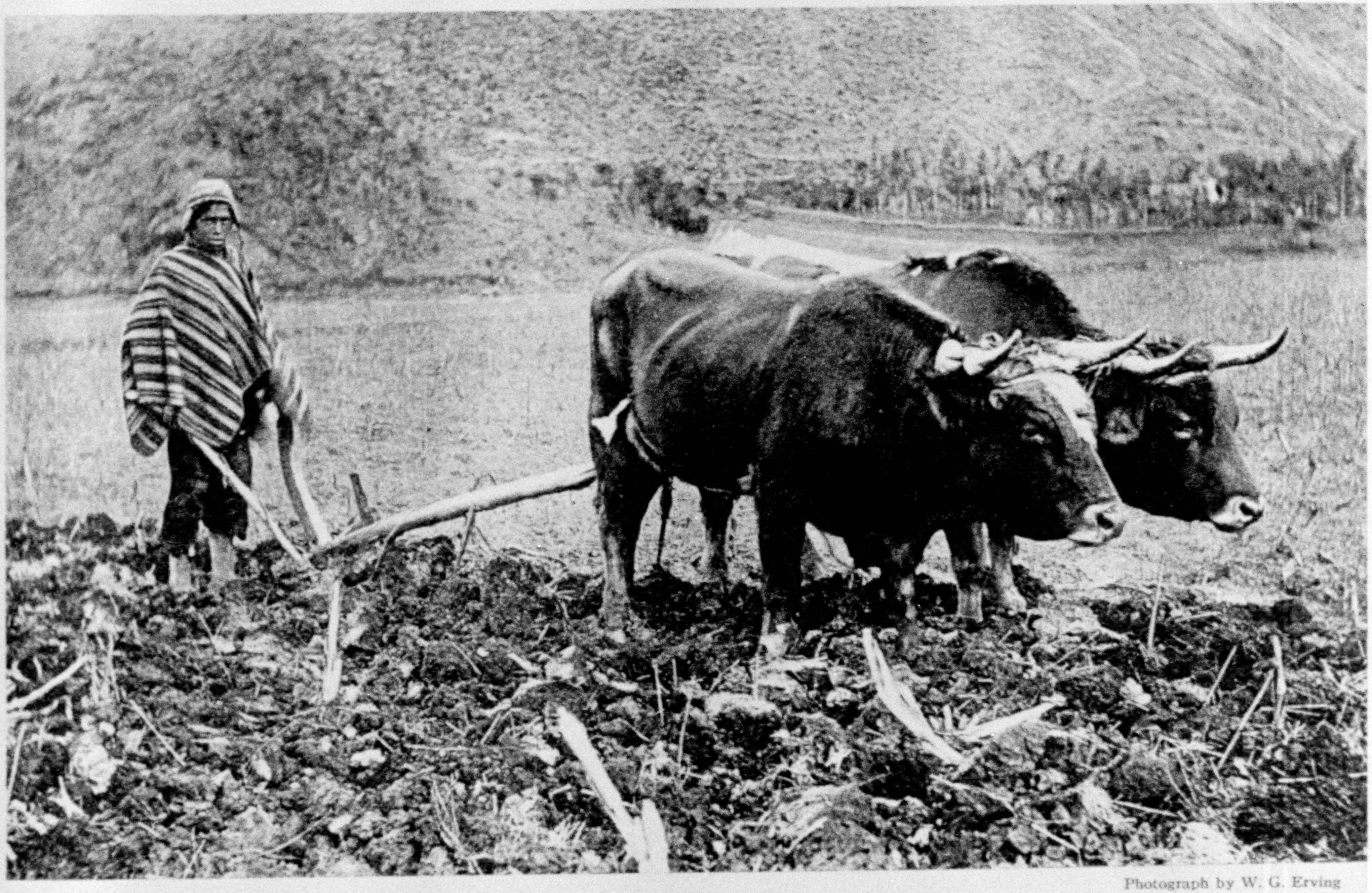


Photograph by H. L. Tucker

A TYPICAL PERUVIAN PLAZA

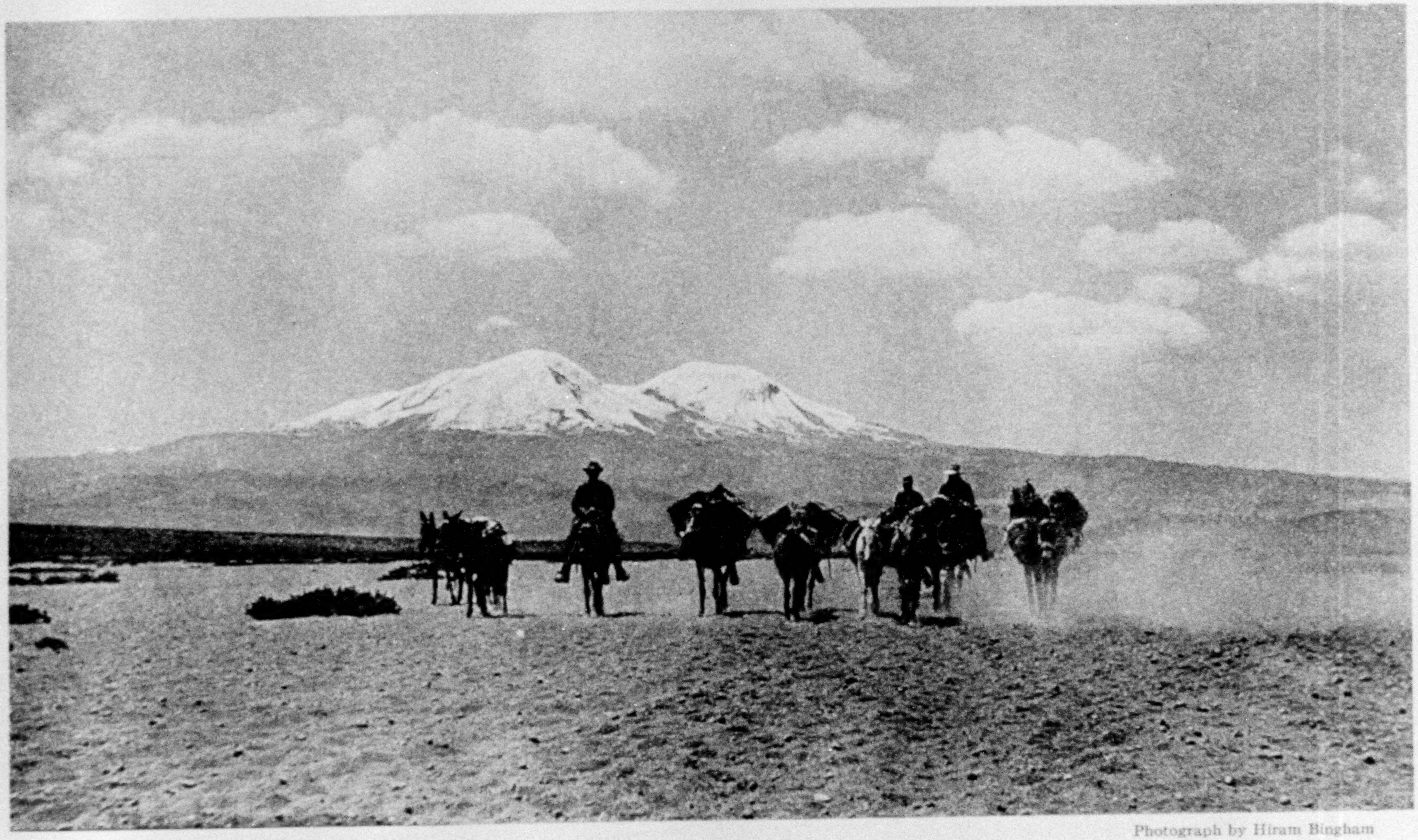
The llamas are loaded with rock-salt. The open sewer in the center of the street is characteristic of most mountain towns.



Photograph by W. G. Erving

PLOWING IN THE CENTRAL ANDES

The plowman is a Peruvian mountain Indian. His oxen are descendants of the imported European stock; his plow is an iron tipped, pointed stick such as his ancestors have used since the Spanish Conquest. The scene is laid in the Urubamba Valley. The chief crop is Indian corn.



Photograph by Hiram Bingham

OUR CARAVAN CROSSING THE COASTAL DESERT AT AN ALTITUDE OF 15,000 FEET: MT. COROPUNA IN THE BACKGROUND, ELEVATION 21,703 FEET

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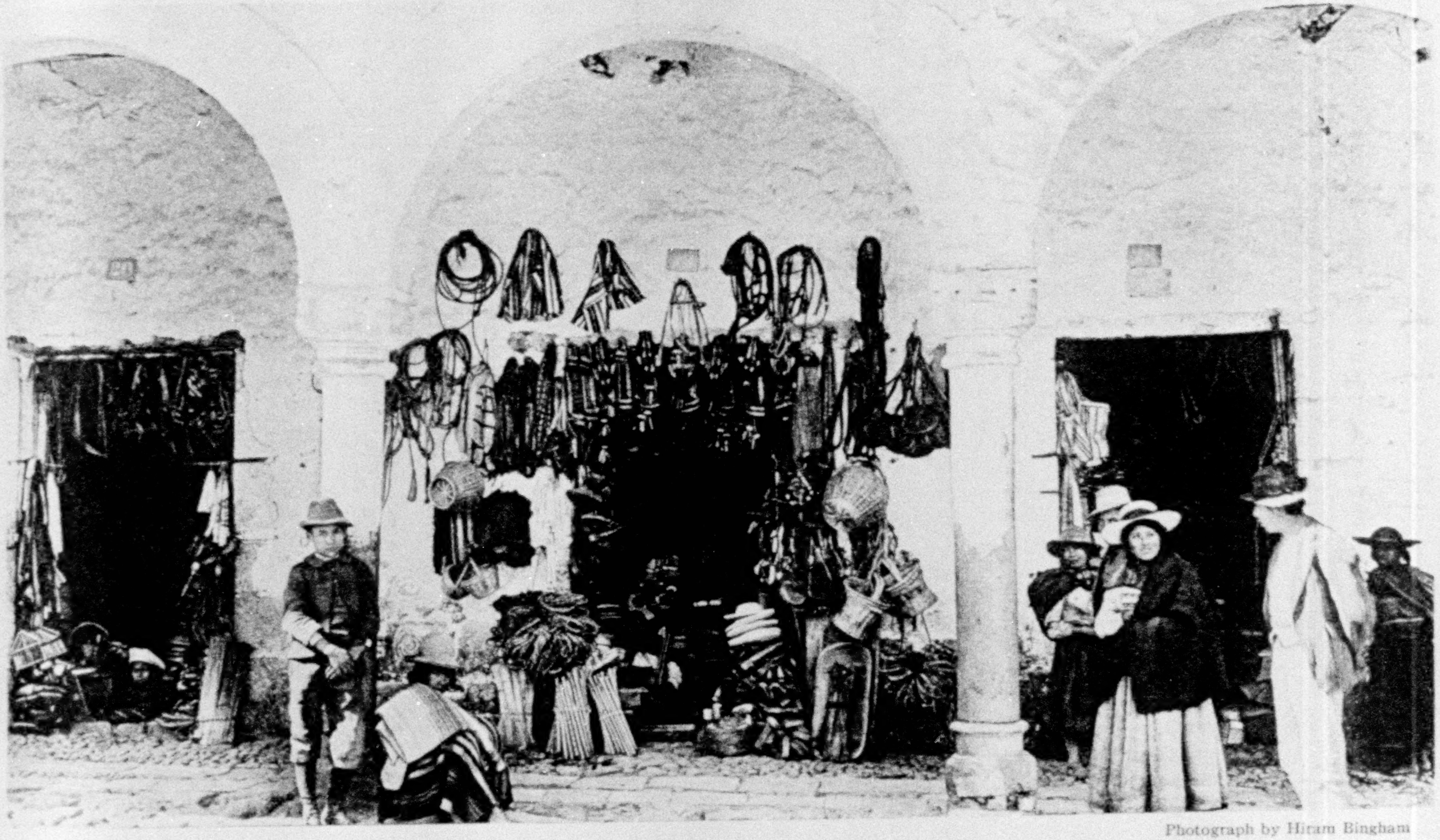
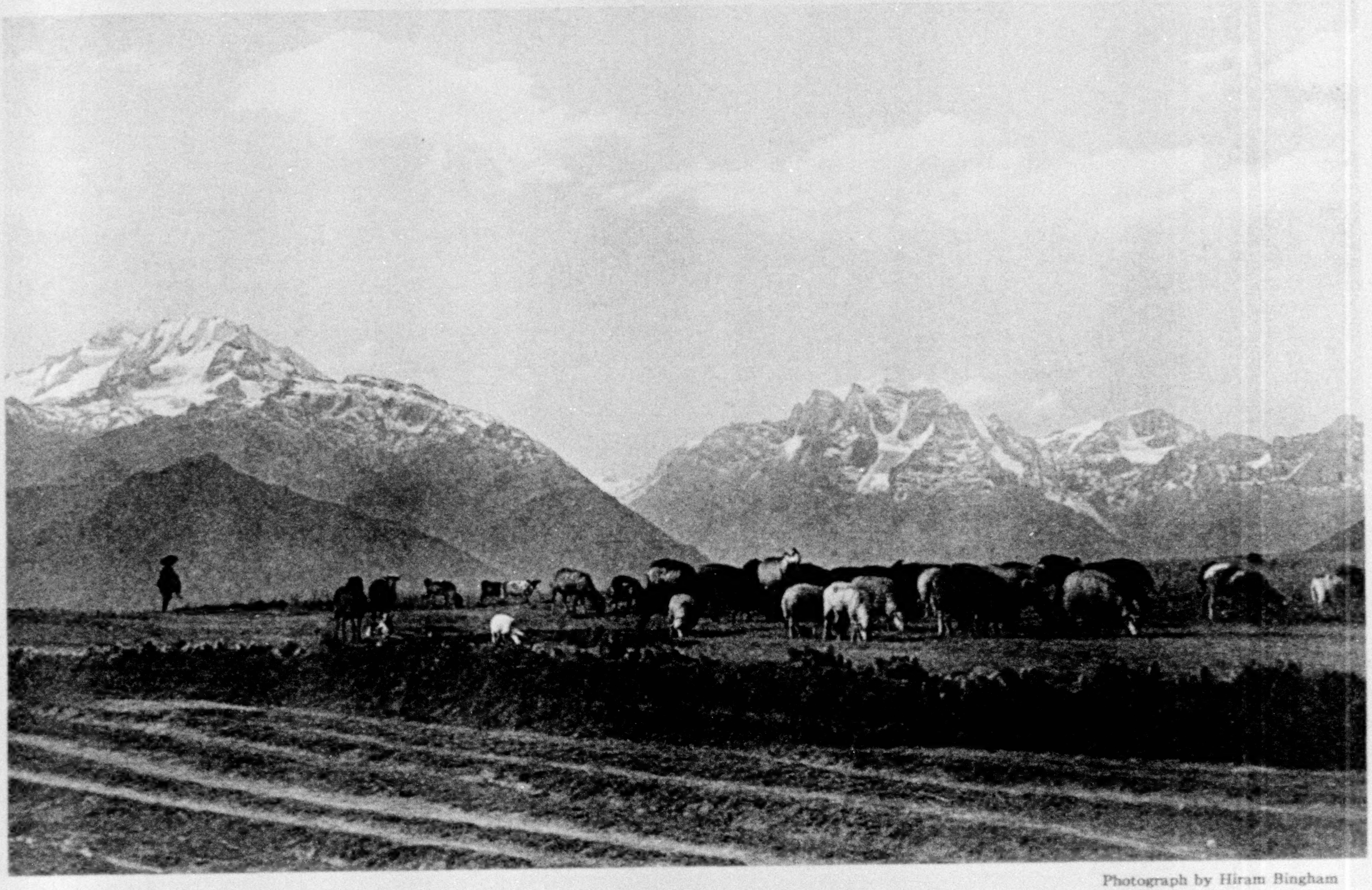


Photograph by Hiram Bingham

A MULETEER'S STORE IN AN ARCADE ON THE GREAT PLAZA OF CUZCO

Here is exposed for sale everything that appeals to the eye and the pocketbook of the Peruvian muleteer. Richly decorated halters, leather knapsacks in which to carry his coca or other valuable articles, and even flutes to while away the weary hours of his journey are here displayed.



Photograph by Hiram Bingham

A BOY SHEPHERD AND HIS SHEEP: NEAR CHINCHEROS, PERU

As soon as they are able to walk the little Indian children of Peru are set to work. They are early taught to collect firewood and forage wherever they can. They have no toys and live a playless childhood. It is not an uncommon sight to see a little three-year-old girl driving home a sheep loaded with small branches which she herself has collected for firewood.

than the Babylonian wonder. A bank of 50 terraces 10 feet high means a vertical height of 500 feet. Many slopes have more than 50 terraces, forming huge staircases as high as the Washington Monument, resting against the lower slopes of mountains that tower for thousands of feet above. It is only by taking the ancient works out of their natural setting that we can appreciate their gigantic proportions.

AN AMAZING SPECTACLE

In the days when they were built, the hanging gardens of Peru must have presented an amazing spectacle. All of the terraced valleys, with their teeming populations, were probably as clean of trees and shrubby vegetation as some of the valleys still are, where people have continued to be too numerous to permit of reforestation. Thus the terraces must have stood out in much greater prominence than they do now, when most of them are abandoned and overgrown with grass and bushes. In some of the valleys in the vicinity of Ollantaytambo reforestation is well advanced and the terraces now support large trees.

THEIR MEMORIALS TO THE GREAT WERE AGRICULTURAL TERRACES INSTEAD OF TOMBS

The building of terraces was developed into a fine art in Peru. *The skilled labor that was lavished in ancient Egypt on the tombs of the sovereigns appears to have been applied in Peru to the construction of gardens of special workmanship for raising the food of the royal family.* The ancient Peruvians made burial structures for the mummies of their dead, but the chief concern was for the living. The tombs were of modest proportions and were placed in caves or set high on the rocky cliffs in the mountains, not in locations suitable for agricultural purposes.

Pressure of population afforded, no doubt, the underlying compulsion to go forward with the construction of the agricultural terraces, and at the same time tended to develop skill and emulation. The natural interest in the permanence of one's work, the desire to do it well, and the wish to have it appear to advantage, doubtless were motives that spurred the ambition of the prehistoric masons, as of artists of the present day. The terraces are beautiful, not only because the stones are finely dressed and nicely fitted, but because the work is fully in keeping with its surroundings and admirably adapted to its purpose. The function of a terrace wall is to stand and hold the soil. Thousands of the ancient terraces have stood through the centuries, and the soil that the ancient people laid down is still in place.

The work that the prehistoric builders accomplished is still beyond our comprehension. Nobody has explained how it was done or how it could be done. Indeed, the modern Indians deny that it ever was done, preferring to believe that it was the work of enchantment. Huge rocks that could have been moved only with the greatest difficulty and by the combined labor of hundreds of people are nevertheless fitted together with incredible nicety. To say that there are seams too fine to insert knife-edges or tissue papers leaves the story only partly told. There is no room for inserting anything, since the surfaces are actually in contact.

With some of the finest work, at Ollantaytambo, the joints are in many places too fine to be seen by the naked eye. A lens becomes necessary to make sure that there is really a seam and not merely a superficial groove, or false joint. Professor Bingham compares the fitting of the stones to the grinding of glass stoppers into bottles, which is the best analogy thus far suggested. But how can anybody credit the idea of grinding together with such accuracy the edges of stones that weigh tons? Obviously the edges must have been ground before the stones were put in place. But the grinding in itself does not seem so difficult to explain as the shaping of the stones with such accuracy that the ground edges fit so absolutely together.

THEIR MASTERPIECES WERE GARDENS INSTEAD OF FORTRESSES

That the masterpieces of the Megalithic art have been described hitherto as fortresses instead of as gardens only shows how far our own race is from appreciating the devotion of the ancient people to their agricultural pursuits. From the nature of their undertakings it is plain that in those days agriculture had the highest consideration. Nothing that human labor could accomplish was too much of an honor to be paid to the art that enabled these ancient people to create for themselves the essentials of a civilized existence, even under very unfavorable natural conditions. Notwithstanding the enormous labor expended upon the building of ordinary terraces, such work was carried far beyond the practical necessities and brought to a stage of perfection that compels us to wonder as well as to admire.

In some respects even the finest of the walls appear very rude, but for that very reason they bear the more overwhelming testimony to the remarkable perseverance of the builders. In what other way could a primitive people have left so convincing a testimony of their attainment of the condition of an ordered society? The people who carried through these undertakings had not only solved the problem of existence and of food supply, but had developed very high standards of artistic perfection, along with the energy and patience to carry them into execution under natural conditions of extreme difficulty and with none but the simplest of tools.

The development of terrace-building into a fine art would follow naturally after the terrace system of agriculture came to be widely used. No people capable of such perseverance in the building of terraces would fail to take pride in their walls, as masons have done ever since. From the very foundation of Rome we have the tradition that Romulus killed Remus in a quarrel over the construction of a wall.

In Peru the building of walls for terraces came in advance of walls for houses or towns, and we may believe that the builders of the finest terraces received the highest appreciation. Building the terraces in more difficult places and making them of harder and larger stones, joined with greater and greater skill, would be natural steps in the development of the art, like the larger and larger pyramids of the successive Egyptian pharaohs. Indeed, when all the conditions are taken into account, it is difficult to imagine any other kind of work in which skill would be so likely to be developed and applied as in the building of these terraces.

THE STRUCTURE OF THE TERRACES

That the terraces, including those of the finest construction, were built for agricultural purposes is obvious as soon as their internal construction is taken into account. Each terrace consists, roughly speaking, of three parts—the wall and the two distinct layers of earth that fill the space behind the wall. *All of the ruined terraces show the same inside structure, wherever the walls are removed.* The strata that are hidden behind the walls are artificial no less than the stone facing (see page 509).

The underlying stratum, or artificial subsoil, is composed of coarse stones and clay, and is covered by a layer of fine surface soil two or three feet thick. The thickness of the subsoil layer depends, of course, upon the height of the terrace. Where clay or other light-colored material is used for the subsoil, the difference between the two layers appears most striking; but the finer texture of the upper layer also renders it very distinct (see page 508).

In height the terraces range usually from 8 to 14 feet, the width depending upon the slope. Terraces on very steep slopes or narrow shelves of rock are sometimes only 3 or 4 feet wide, though the usual range is from 8 to 15 feet, or still wider on the more gradual slopes. Banks of 20 to 30 terraces are not uncommon, while 50 or more are found in many cases.

That some of the stones and soil for building the terraces was carried by llamas is not impossible, but does not seem very probable. Most of the terraces are at elevations below 11,000 feet, while llamas are used chiefly in the higher altitudes. Probably most of the soil was moved in baskets or mats carried on men's backs.

There is a tradition that earth for the Inca garden at Cuzco was brought from a special place near Quito, some 700 miles

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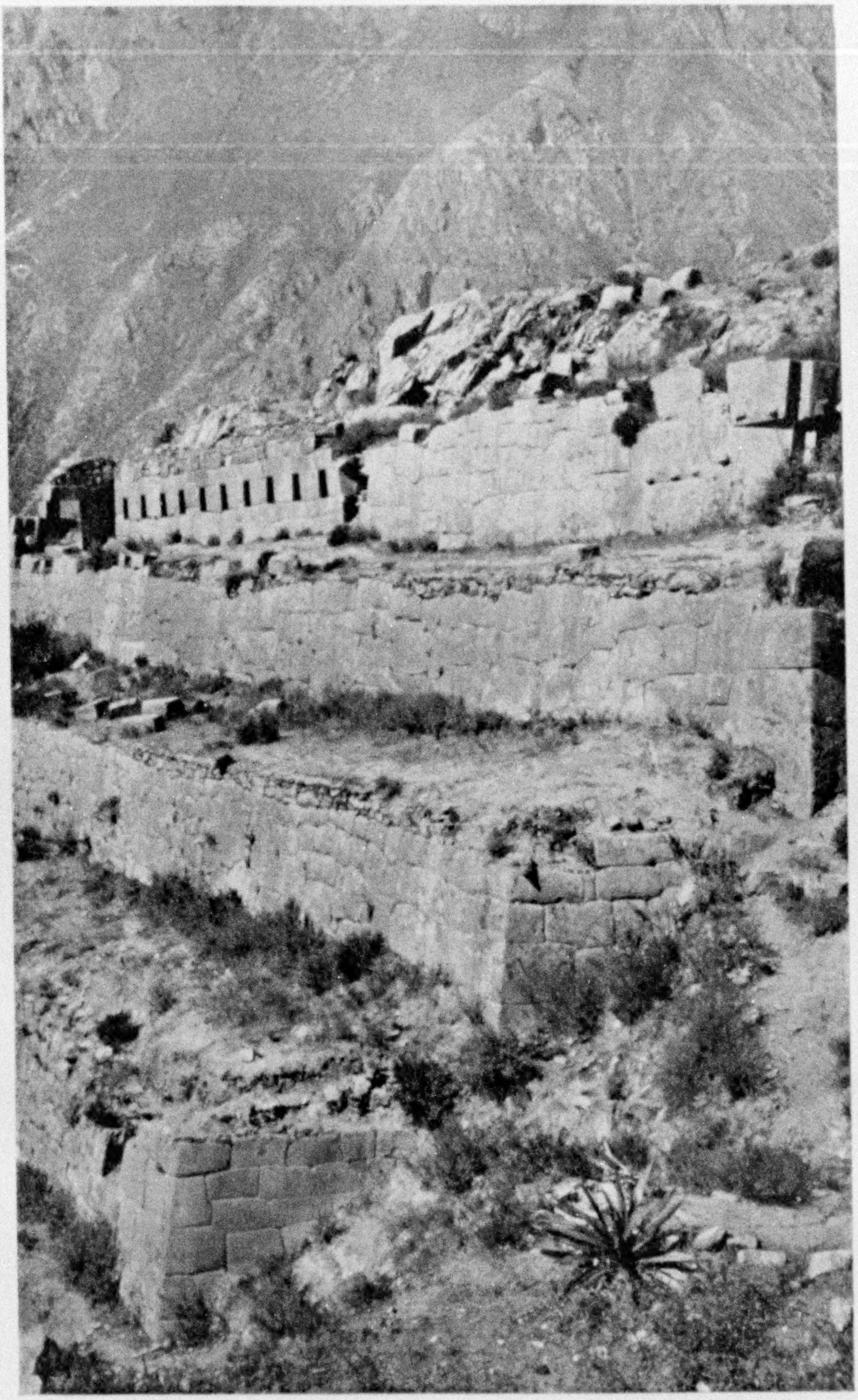


Photograph by O. F. Cook

A FEW OF THE FINEST MEGALITHIC TERRACES OF THE HANGING GARDENS OF OLLANTAYTAMBO

Some of the stones have been torn away near the corners of the terraces, and the upper layer of fine agricultural soil is partly exposed. The row of niches in the upper terrace may have corresponded to a row of windows in an outer wall, thus inclosing a long passage or corridor, with a doorway at either end, of which one remains (see page 438).

XUM

away. This may be taken at least as an indication that soil was carried sometimes for long distances, and in such cases it probably was transported on pack animals.

THE WATERING OF THE TERRACES

Water was brought to the terraces from the slopes above in artificial channels or acequias leading down, often for many miles, from the gorges of the high mountains, where they intercepted perennial streams fed by the melting of the glaciers and snow-fields (see page 504). Careful provision was made to avoid erosion of the soil or injury to the walls.

Three different methods of bringing the water down from one terrace to another are to be seen about Ollantaytambo. Some terraces have narrow vertical channels near the ends of the retaining walls. In other banks of terraces the water was brought down over large upright stones and caught in a basin below.

The third method was to carry the water down along the walls at the ends of the terraces, which were set with double rows of stones to form the water channel between.

Long banks of terraces are interrupted at intervals by passageways that doubtless served the double purpose of roads for reaching the terraces and of drainage channels to bring down surface water from the slopes above, and thus avoid the danger of having the terraces washed away by heavy rains.

The handling of the water on the terraces undoubtedly was greatly facilitated by the fact that the soils in all the terraced districts are extremely tenacious and not readily eroded. A few sods or a small ridge of earth will hold in check a stream of water, even with a swift current.

THEY PROBABLY HAD SHOWER-BATHS

A special feature in terrace watering was indicated at Machu Picchu, where many large stones, deeply grooved lengthwise, lie scattered along the terraces. Such stones might have served as spouts to carry the water out from the terrace wall, and thus avoid still further the danger of erosion or undermining of the wall.

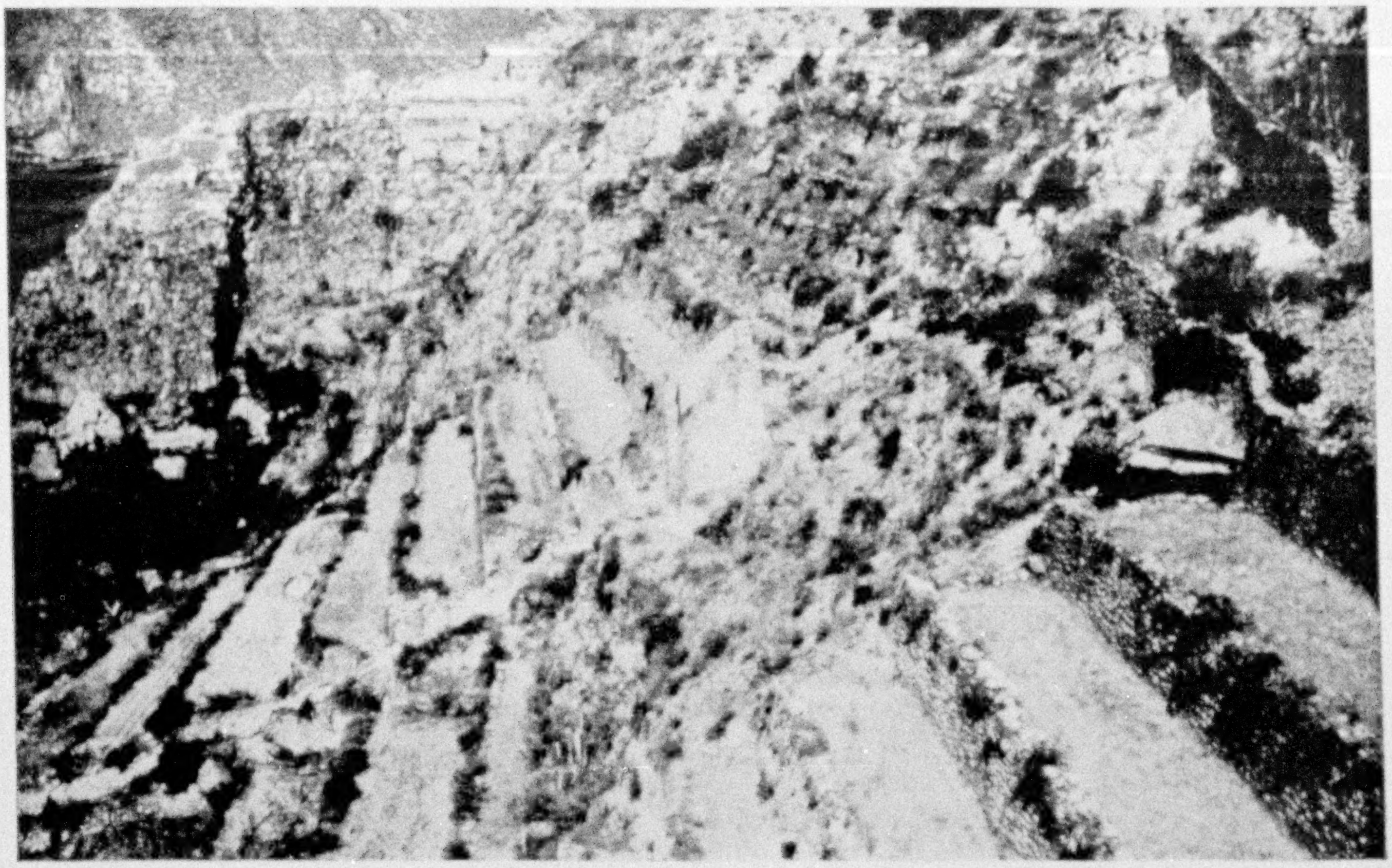
The idea of hanging gardens watered by small streams or jets falling through the air affords an attractive possibility in the existence of the ancient people. Conducting the water down over the terraces in this way would afford ample shower-bath facilities for the people who worked on the terraces. Let us at least cherish the hope that the so-called "baths" found in the ruins of Machu Picchu and elsewhere were not merely basins where water was dipped up in jars, and that the ancient people were not as deficient in ideas of bodily cleanliness as their modern descendants. Ethnologists are familiar with the fact that the introduction of European clothes has tended in many countries to destroy habits of cleanliness among primitive peoples.

A LAND-STARVED PEOPLE ACCOMPLISH THE INCREDIBLE

Some of the most laborious terracing is not on the steep slopes, where the terraces are high-walled and narrow, but in the bottoms of the valleys, where the terraces are often very broad. The building of broad terraces required more labor because it involved the filling and leveling of much larger areas behind the walls. Much of the work could have been avoided by making larger numbers of lower and narrower terraces, but the walls would have been more numerous and would have occupied more of the surface.

With labor very abundant and land very scarce, the ancient engineers followed the plan of making the terraces as broad as possible, sometimes even to the extent of bringing material and filling in behind walls 15 or 20 feet high. Thus it would be very conservative to estimate that the building of the broad, valley-bottom terraces involved the handling and replacing of the earth for an average depth of at least 6 feet over the entire surface. This allows 3 feet for the surface layer of fine soil and at least an equal depth for the subsoil layer.

The labor would depend, of course, on how far the material had to be carried. Some of it may have been moved only a few feet, some a few yards or rods, but some must have been brought for considerable distances, as when areas of cul-



Photograph by O. F. Cook

SOME OF THE STAIRCASE FARMS OF THE ANCIENTS

Each terrace consists of three parts—the wall and the two distinct layers of earth that fill the space behind the wall. *All of the ruined terraces show the same inside structure, wherever the walls are removed.* The strata that are hidden behind the walls are artificial no less than the stone facing (see also illustrations, pages 508 and 509).

The underlying stratum, or artificial subsoil, is composed of coarse stones and clay, and is covered by a layer of fine surface soil two or three feet thick. The thickness of the subsoil layer depends, of course, upon the height of the terrace. Where clay or other light-colored material is used for the subsoil, the difference between the two layers appears most striking; but the finer texture of the upper layer also renders it very distinct. The lower terraces of this bank are still under cultivation. In the background a part of the megalithic terraces can be seen. A ruined Inca house stands near the base of the precipice at the left.

tivated lands were widened by building new terraces along the beds of the streams.

In many cases the work was evidently planned so that large immovable boulders or outcrops of rock could be utilized in the building of the walls instead of being allowed to diminish the area of cultivated land. We may believe that powder or dynamite, to shatter refractory rocks, would have been very highly appreciated among the ancient Peruvians.

STRAIGHTENING OF RIVER BANKS AND STREAM BEDS

It would be a mistake to suppose that reclamation work in the bottoms of the valleys was wholly or even principally of the nature of improving irregular land by terracing and leveling behind the walls. A large part of the surface of the valley bottoms must have been altogether bare of soil, as the unimproved portions still are—mere wastes of loose stones brought down by the torrential floods.

The natural behavior of swift mountain streams is to cut irregular channels back and forth between the walls of their valleys, but in the terraced valleys of Peru it is the regular condition to find the rivers and smaller streams confined to channels of definite width, and sometimes kept in straight courses for several miles at a stretch, as in the case of the Urubamba River near Pisac, and again below Ollantaytambo. In the latter instance the river runs for nearly five miles in a straight course, and, although the ancient walls that were built to confine the river have remained intact in only a few places, the artificial nature of the channel is obvious.

A road that runs along the river has utilized the top of a buried wall as a pavement. These buried walls, which occur also in other places, make it evident that narrowing of the channel of the river was accomplished by gradual stages. In this case the area of cultivated land was widened for about 12 feet toward the river by building a new wall closer to the river and filling in behind it. The old wall was left in place, but buried in the mass of the terrace and covered with earth so that it did not interfere with the cultivation of the land. Thus the land-starved people gained an additional strip of land, only a few feet wide, but several miles long. The river may have furnished the stones for the new wall, but the layer of surface soil must have been brought from a distance.

THESE ANCIENT PERUVIANS BUILT AQUEDUCTS THAT ARE UNEQUALED ELSEWHERE

The ancient aqueducts of Peru have challenged the most attention from former travelers, and they do not become less worthy of admiration because they are now seen to be only one feature of a highly specialized agricultural system. The construction of the irrigation channels was an enormous undertaking, perhaps not equaled in any other part of the world. From the aqueducts alone it is evident that agriculture must have attained a high development, which may explain why the other branches of the art have received less consideration.

How numerous and extensive the ancient aqueducts really were may never be known, but the subject is worthy of much more extensive study than it has received thus far. If the accounts of early Spanish writers are to be accepted, some of these aqueducts were very long. Garcilasso wrote of one of them as 55 leagues long and another 120 leagues, with a depth of 12 feet.

Where the soil was loose the channels were paved with stones for many miles. On rocky slopes or precipices channels were cut into the cliffs, and in some cases tunnels of considerable length are said to have been drilled.

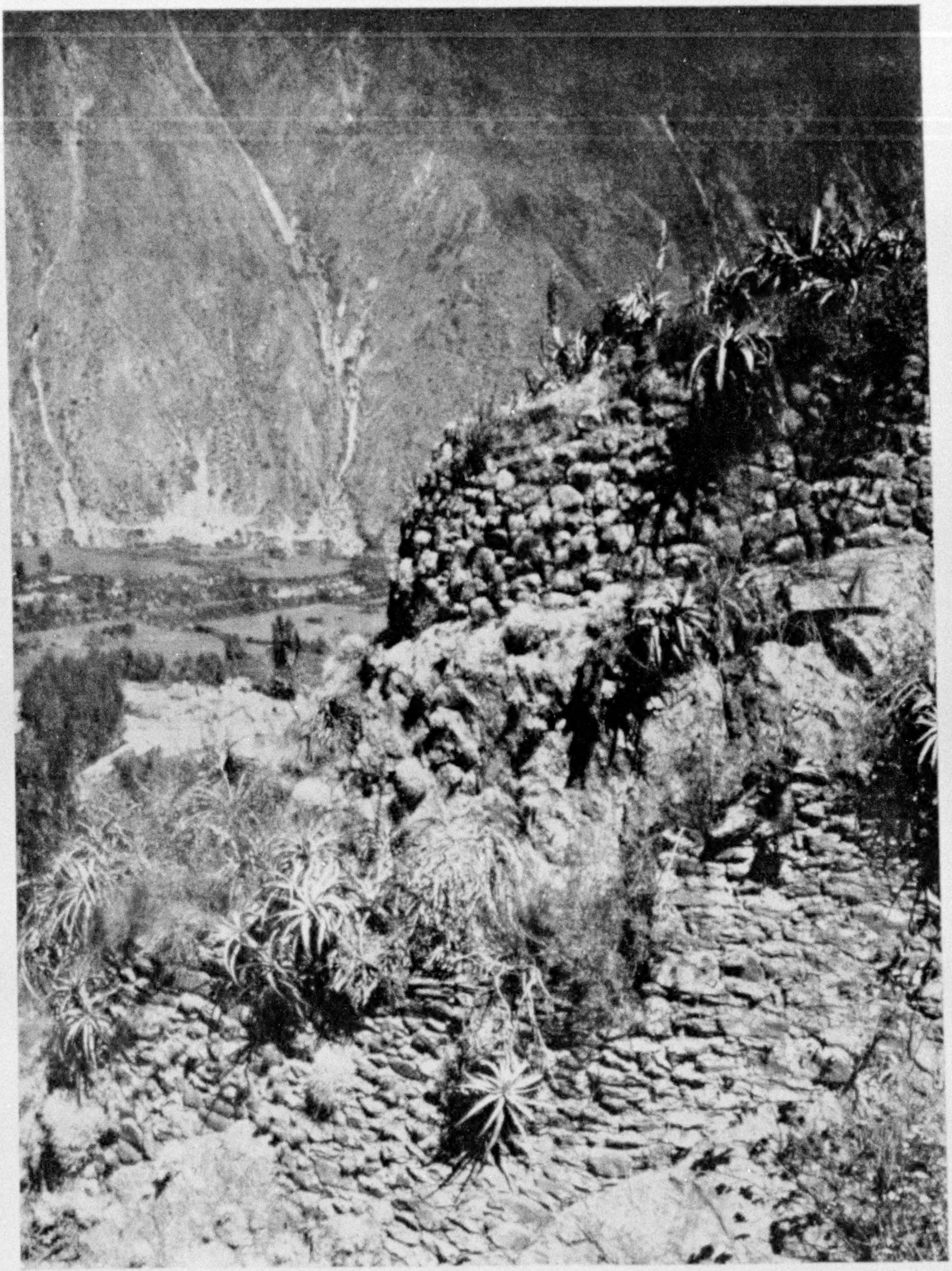
Where channels were being carried along the sides of steep slopes, the usual method of passing vertical surfaces or overhanging rocks was to build up a wall from below to the height of the channel. In sheltered angles such walls remain in place after the channels that ran along the exposed slopes have entirely disappeared.

WHERE SQUASHES ARE TIED

The favorite courses for the ancient irrigation channels, and by far the best from an engineering point of view, were along the very crests of the ridges and spurs of the mountains. In such places the water-courses were cut, and now have worn deep grooves. Thus there is no danger of the channels washing away or being filled up by drainage from above, as with channels that run along the slopes (see page 517).

Cultivation was by no means confined to the walled terraces that usually follow the lower slopes of the mountains, but was carried all the way up, on any slopes that were not too steep to permit the accumulation of soil. It was not necessary to build terraces to get rid of rocks on slopes that are so steep that rocks roll off. Slopes are even now cultivated where squashes have to be staked or tied to keep them from rolling down the mountain, and where potatoes must be picked instead of being shaken from the vines. As these higher slopes are cool and cloudy, there is much less need of irrigation than in the valleys below.

Though stone terraces were seldom built on the high slopes, a system of narrow earth terraces or transverse ridges, somewhat analogous to the contour farming in our Southeastern States, was in general use. Remains of such ridges cover large areas of the higher slopes. Usually there are a few large ridges at intervals, with numerous smaller ridges between. Many of these smaller ridges can be seen from the valleys below only when the light comes from a particular angle, so as to cast shadows across them. When lighted from in front the inequalities are not shown, and nobody would suspect that such steep slopes, now producing only a sparse and scattered



Photograph by O. F. Cook

TERRACES ON NARROW SHELVES

In addition to the terraces of regular form built in banks, any irregular shelf of rock that would support a wall was likely to be used as an agricultural terrace. In this case the shelves were so narrow that the terraces could have been only three or four feet wide—hardly room enough for more than one row of potatoes.

XUM

growth of bunch grass, were once cultivated (see illustration, page 511).

In one place just below Urcos a narrow strip between broken precipitous rocks is covered with short transverse ridges like a stairway.

The areas that have been farmed in this way are very extensive, much more so than the lands that are still cultivated in the valleys below. A few of these high slopes are still cultivated, but most of them have been abandoned. Where the lands are now used by the Indians, the same system of transverse ridges is employed. The larger ridges at intervals have the effect of preventing, or at least impeding, erosion. These ridges are not cultivated, but are left in grass, and thus serve to let the water run down the slopes without allowing it to cut channels, thereby having the function of spillways or "drops" in irrigation systems.

EVEN THE GLACIERS RETREATED BEFORE THEIR INDUSTRY

Riding for many hours, or even for days, through valleys where all of the upper slopes show signs of having been cultivated in former times, and very few are cultivated now, eventually gives one an almost oppressive feeling of the past that has vanished long since, and yet is so ever-present that the eye can scarcely avoid it, even when one looks up to the glaciers and the eternal snows. The people who grew potatoes on the high slopes must have stood in their day against the same icy background. Indeed, their agricultural activities may have driven the very glaciers back, by gradually clearing the mountain slopes and exposing them to the sun, just as they narrowed and straightened the river torrents by hemming them in with successive walls of rock.

That the glaciers formerly extended much farther down is shown by the positions of the moraines. There can be little doubt that the whole aspect of the country has been altered profoundly during the very long period of intensive agricultural occupation. Biologically speaking, there is every reason to believe that most of the cultivated lands had a forest covering originally, and that the present state of denudation is largely artificial. Remnants of a native forest flora are still to be found in places too rocky and broken to be cultivated, even by the strenuous methods of the ancients.*

A RECLAMATION AGRICULTURE

From the facts already stated, it is apparent that the ancient agriculture of the interior valleys of Peru was to a very large extent a reclamation agriculture—that is, an agriculture involving community organization and planning in advance. Only a very small part of the land that was used was naturally adapted to the raising of crops. Much of it was too dry to grow crops without irrigation, and even more of it was so steep or so rocky that the surface had to be terraced or otherwise reformed in order to make it suitable for cultivation.

Of the four forms of reclamation that were so extensively employed in ancient Peru not one has been used, or even seriously considered, in the United States. Nowhere do we cultivate steep lands like the higher slopes of the Peruvian valleys, or build stone walls to support narrow terraces, or place artificial soil on broad terraces in valley bottoms. In a few places we are beginning to straighten and confine our rivers to make more land along the banks, but chiefly with the object of preventing floods or reclaiming broad, level lands by drainage, not with the idea of building new lands in the rocky beds of torrents, as in Peru.

COÖPERATION FOR THE COMMON GOOD

Primitive the ancient Peruvians were in many ways, as their modern Quichua descendants still are; but with respect to agriculture and some of the attendant arts a very high state of development must have been attained and at a remote period. Otherwise it would have been impossible to occupy and reclaim many of the places that evidently were centers of population in ancient times.

Many localities must have been treated as reclamation projects from the very

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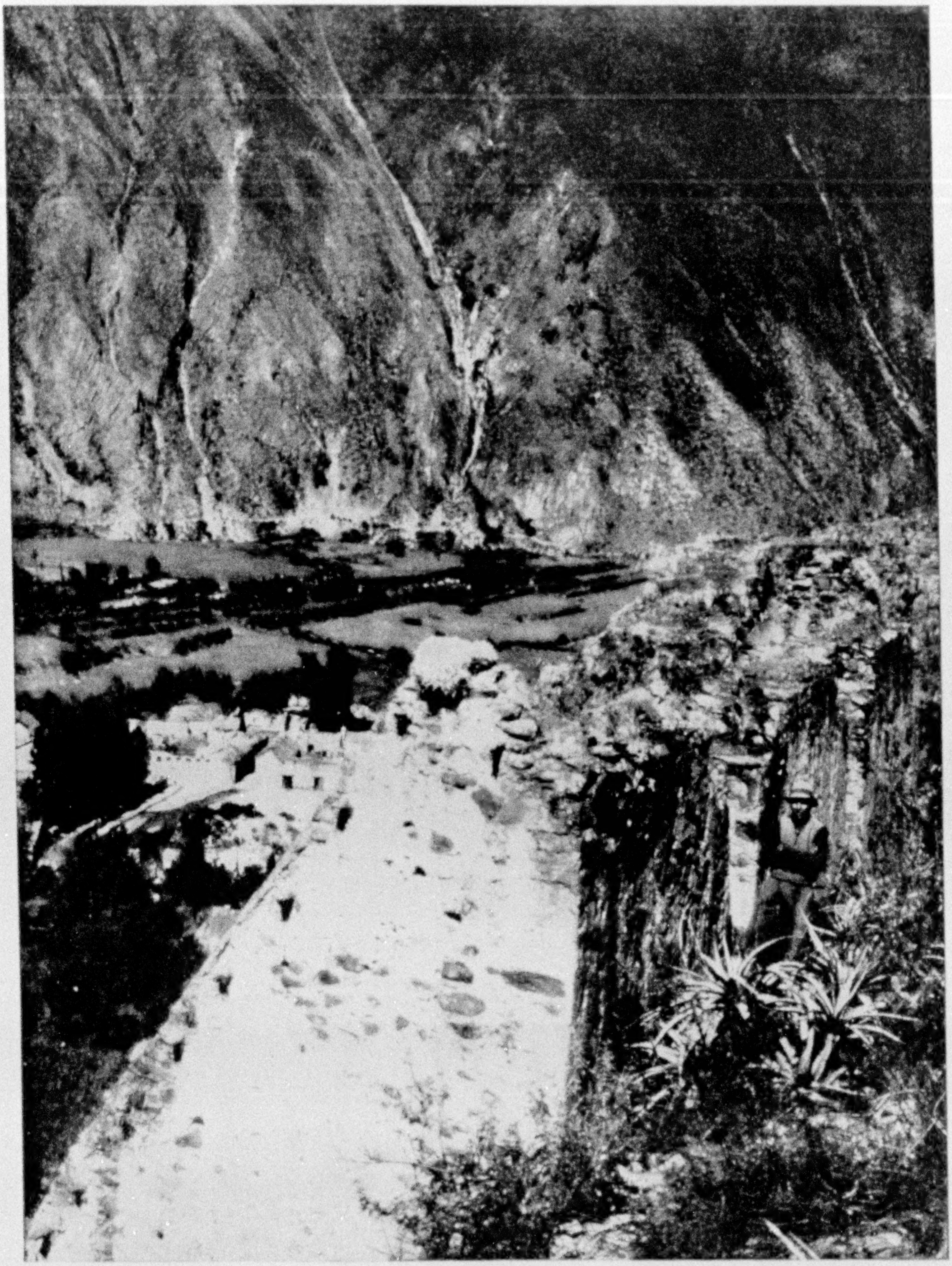
* For a more detailed treatment of these matters, see "Agriculture and Native Vegetation in Peru". Journal of the Washington Academy of Sciences, Vol. VI, pp. 284-293.



Photograph by O. F. Cook

WHERE THE CROPS OF THE INCAS WERE STORED

Storehouses represent a very specialized branch of Inca architecture. A long, narrow building, with one wall much higher than the other and a curious half-gable roof tied to projecting stones, typifies this kind of structure. The width of these storehouses inside the walls is usually less than eight feet, and many of them are built in small sections, which are nearly square. The one shown in this photograph was about 28 feet long and 25 feet high. The walls are about 30 inches thick, of stones laid in clay and stuccoed with clay mixed with grass. The unusual height of the building, the arrangement of the windows, and the lack of any indication of an upper floor argue against its use for human habitation. It is far more likely that this type of house was built for the specific purpose of a granary or storehouse.

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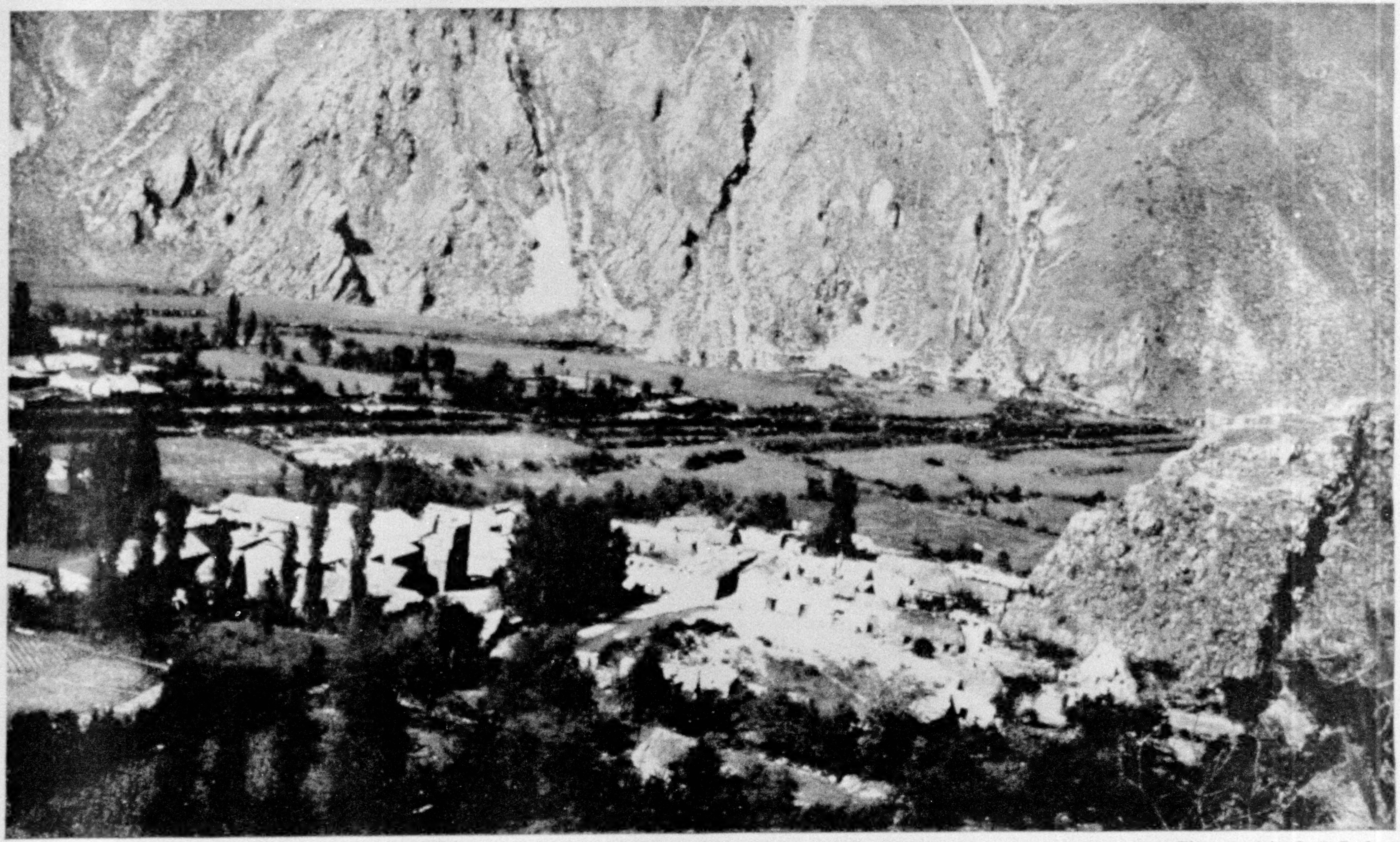


Photograph by O. F. Cook

TERRACED VALLEY BOTTOM AT OLLANTAYTAMBO

All the open fields are broad, artificial terraces. A large aqueduct or causeway, about a mile long, carried on walls 15 to 30 feet high, seen in the middle of the picture, crosses the valley in a nearly straight line. A part of the town is seen in this view from the northern bank of elevated terraces or hanging gardens. In the lower right-hand corner is the end of the projecting ridge that carries the hanging gardens. The town is surrounded on three sides by large agricultural terraces (see pages 438 and 440). The valley at this point is about a mile broad and overhung by steep mountains about a mile high. Several banks of terraces, their true size dwarfed by the mountain above, can be made out along the base of the rocky slope. This view is from the slope above the hanging gardens.

first. They could not have been occupied in any desultory way by colonists or settlers acting separately as individuals. This is plain from the natural conditions and from the nature of the work that had to be done before the crops could be grown to support the colonists.

In many places the aqueducts afford the only permanent supplies of water for human uses as well as for the irrigation of crops. Deliberate planning is also shown in the placing of the aqueducts and terraces, and in the regular way in which the lands of the ancient reclamation enterprises were laid out. Large areas appear to have been developed as units, on the basis of carefully considered undertakings. If the valleys had been settled first by unorganized individuals, at liberty to take lands where they liked, the most favorable places, where the lands were nearly level, would have been occupied first. The tendency would have been to pile up the stones around the boundaries of the fields, which would take the form of irregular circles or fans, like those that occur in some localities.

An excellent example of the results that naturally would follow from a desultory occupation was observed in the Urubamba Valley, near Calca, in a district where crops can be grown without irrigation. The contrasting conditions are represented by the district around Ollantaytambo, where evidences of regular planning are encountered on every hand. The regular planning of the ancient Peruvian cities has been remarked by Wiener, who gives the plan of Ollantaytambo as an example; but the regularity in the laying out of the lands and irrigation works affords still better evidence that the plan was made before the district was occupied. A town site might be changed or reorganized by a powerful chief, but it would be more difficult to believe that all of the agricultural lands would have been readjusted if they had been occupied at first in a desultory manner. In the Peruvian system *the agricultural structures are more permanent than the dwellings.*

In relation to agriculture the results of archeological research in the two hemispheres present a striking contrast. In the Eastern Hemisphere the general result is to show that the civilizations supposed to be the most ancient are not really primitive or aboriginal. They did not have their beginnings and early development in Egypt or Mesopotamia, but were brought from elsewhere. The early dynastic Egyptians came into the Nile Valley from the East and the early Babylonians into the valley of the Euphrates from the South. Nor does it appear that either of these alluvial valleys afforded natural conditions that were really favorable to the practice of agriculture by a very primitive people, nor types of plants suited to domestication.

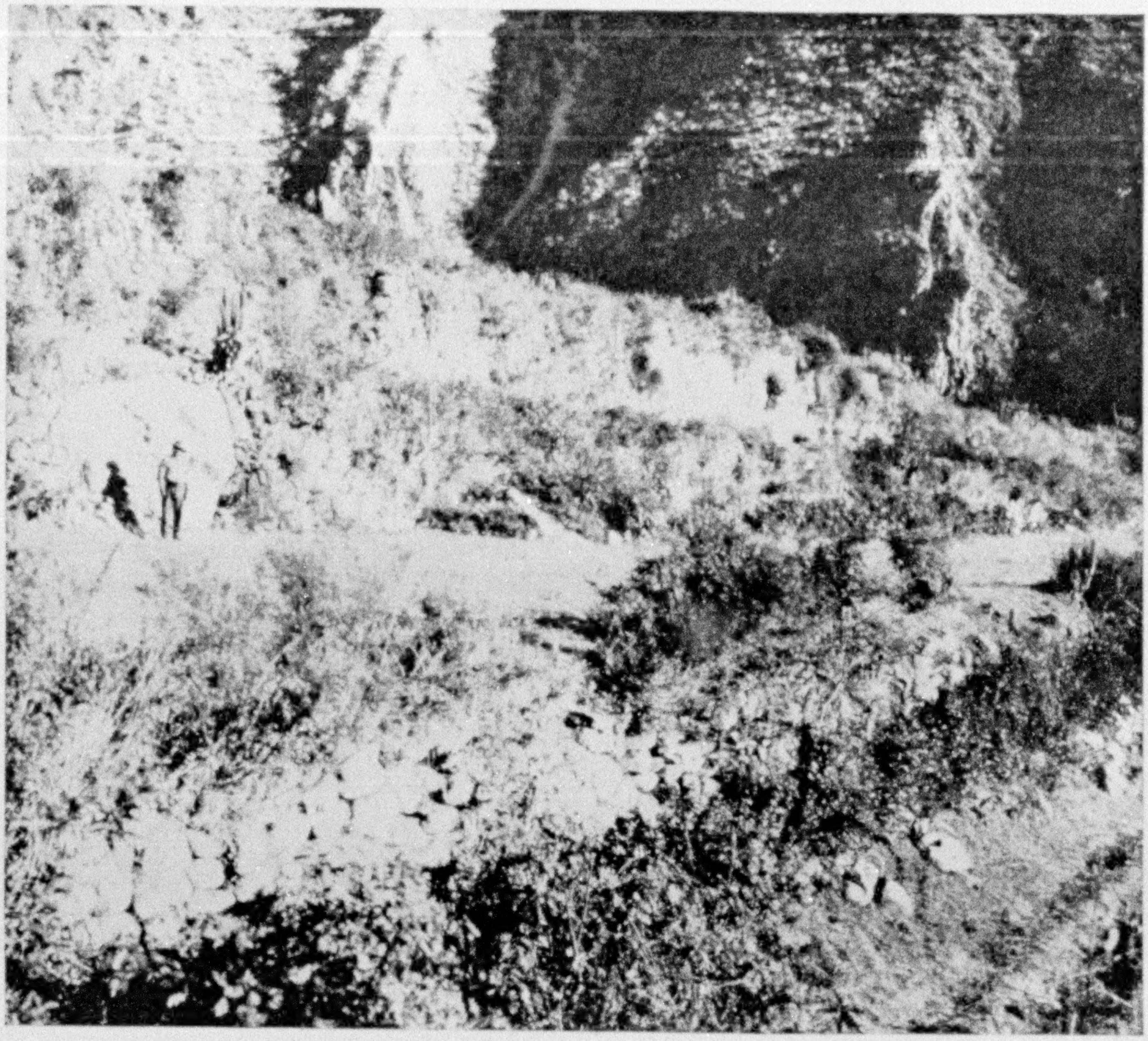
A MOST INTERESTING COMPARISON

The crop plants as well as the ancient agriculturists came into the valleys as a result of colonization. In other words, the valleys were developed as reclamation projects by peoples already skilled in agricultural arts and with an established social organization.

Where these civilized colonists came from is still a question. They are supposed to have come into Egypt and Mesopotamia from southern Arabia and to have been a maritime people, as well as agricultural; but they have not been traced back to their original home or to the place where their agriculture and other arts were developed.

The study of agriculture in America has led to directly opposite results. The older idea that the primitive civilizations of Mexico and Peru were originated by colonists from China, the Malay region, or the East Indies has gradually given way to a belief among archæologists and ethnologists that the primitive civilizations of America were developed entirely on the American continent. Certainly this appears to be true of the art of agriculture. All of the economic plants on which the ancient American agriculture was based are now believed to be of American origin, and a very large proportion of them appear to have come from South America, and especially from the region of Peru.

Of course, it would not follow that agriculture might not have originated in other places as well as in Peru. All that



Photograph by O. F. Cook

ANCIENT AQUEDUCT AND TERRACES

A portion of the long walls crossing the Urubamba Valley at Ollantaytambo, shown in the general view on page 502

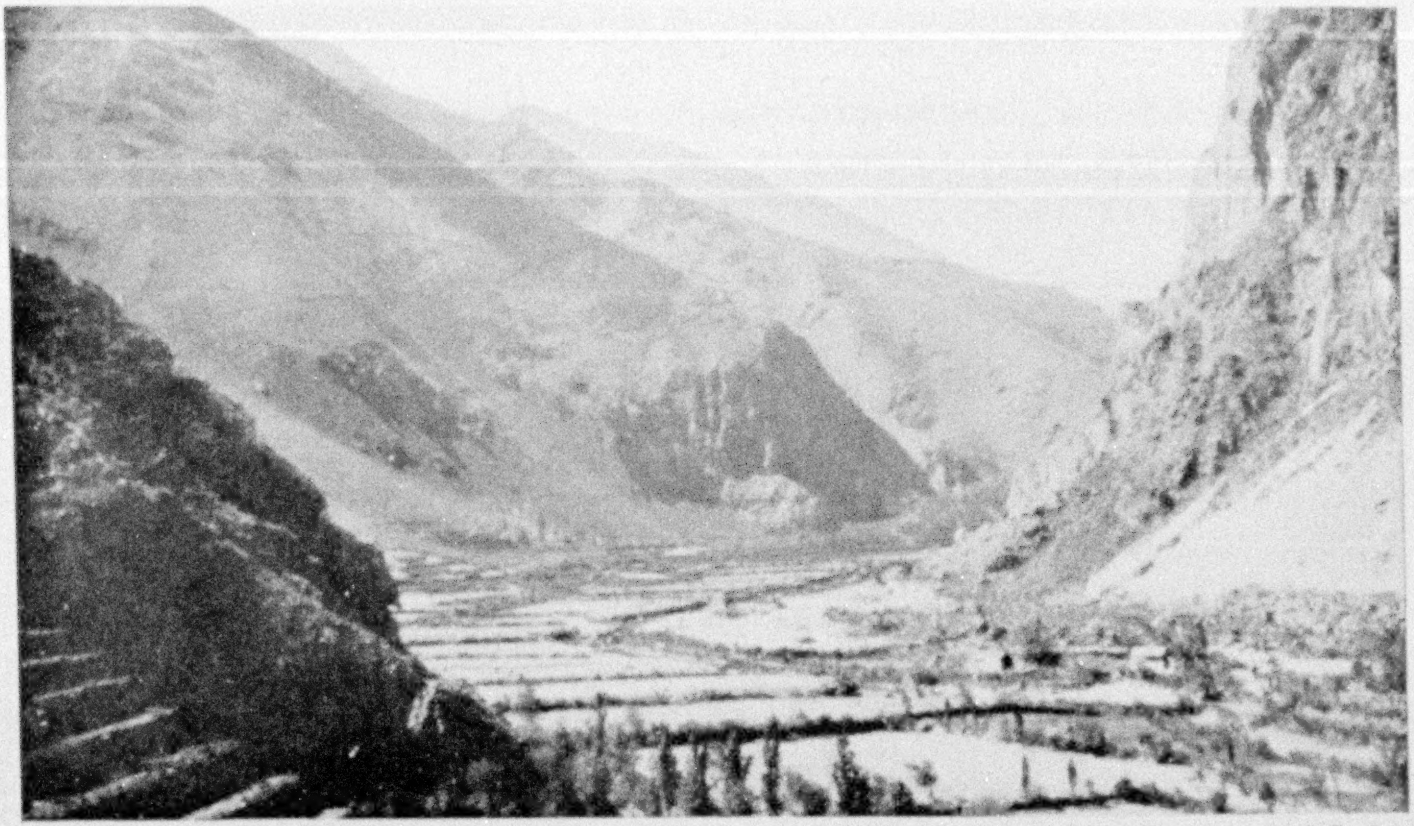
can be said now is that the indications of such a center of origin and domestication of plants in other parts of the world are less definite than in the region of Peru.

It may be that the deep, narrow valleys of Peru imposed conditions necessary to the development of agriculture, at least in its very early stages. The difficulties of communication would mean that each valley must have had its own group of people, separate from all of the others, and that each of these independent communities was restricted to a narrow range, with only a limited stock of natural products to draw upon, and hence under pressure to learn how to increase the growth of the useful plants and destroy their useless competitors.

Whatever the motive or the pressure that led to the development of agriculture under such conditions, of the fact there can be no doubt. That the system of agriculture did develop here is proved by the fact that the plants on which the agriculture was based were indigenous, and that no such system existed in other parts of America.

YOU CAN LOOK FROM THE EQUATOR TO THE POLES

Agriculture in Peru is a matter of altitude. Geographically you are in the tropics, but agriculturally you may be anywhere between the Equator and the northern limit of agriculture, at the Arctic Circle. Moreover, you can find this



Photograph by O. F. Cook

A TERRACED VALLEY ABOVE OLLANTAYTAMBO

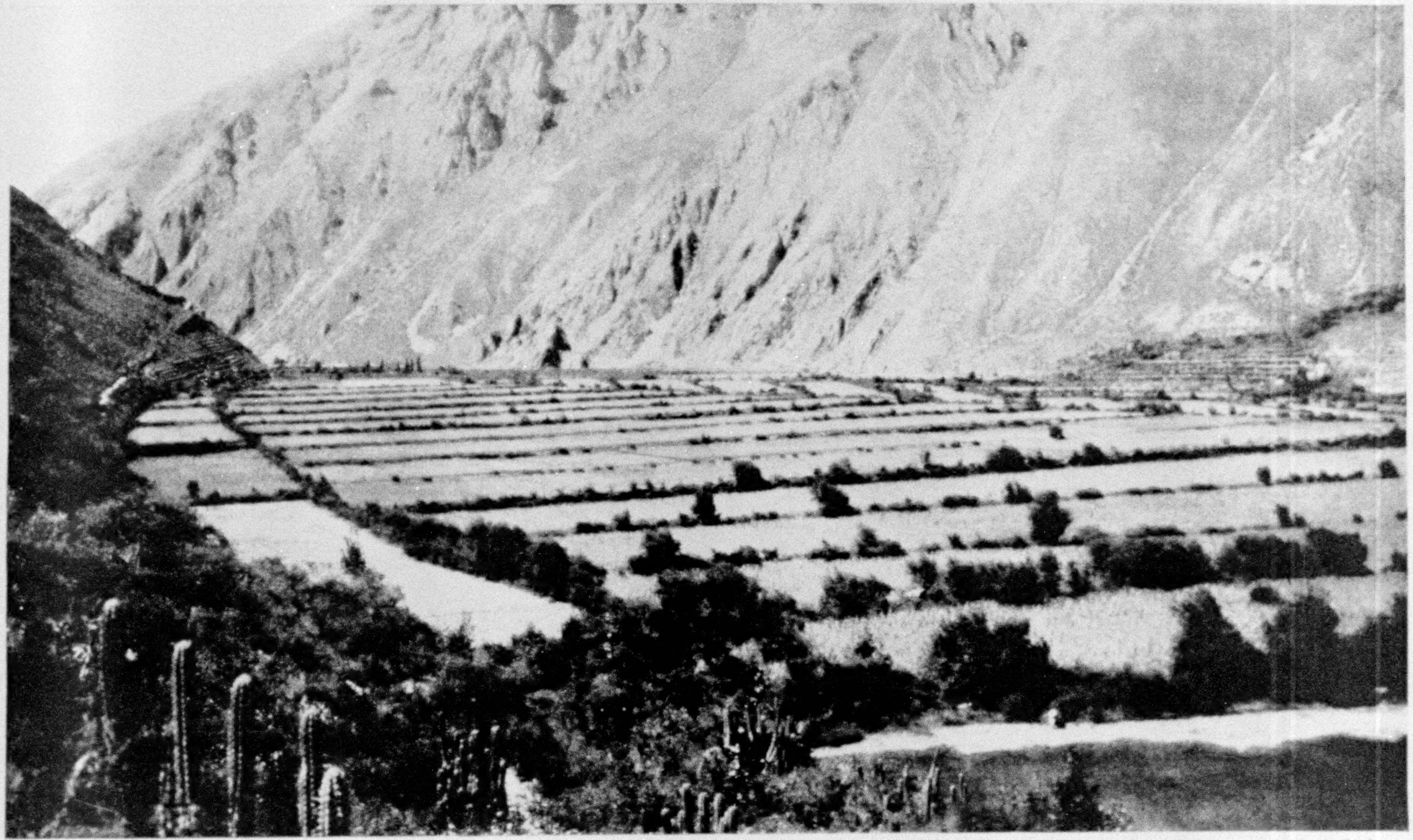
The terracing of this narrow valley is amazing. Parts of it are shown in several photographs that follow (pages 506 to 518). The high slopes at the left were also cultivated in former times. At the base of the steep mountain on the right is a large slide of loose stones, several hundred feet high. All this flat valley is artificial—that is, it was a gully—and would so have remained if the Peruvians had not broadened it and leveled it out (see text, page 406).

range of conditions, not by going to different parts of the country, but in different parts of the same valley, in places within plain sight of each other. Thus from among the plantations of sugar, coca, or cacao, at Santa Ana one can see at the other end of the valley some of the peaks of the Cordillera, covered with glaciers and perpetual snow. It is like looking from Jamaica to Alaska. Even on foot or on mule-back only a few hours are required to climb up or to descend through the full range of agricultural possibilities.

No very definite division into agricultural belts is possible. Some crops are confined to the high altitudes and others to the low, but there is endless overlapping with the intermediate crops. Three agricultural belts can be distinguished on the basis of the principal food plants. The cultivation of cassava, called *yuca* in Spanish and *rumu* in Quichua, may be allowed to characterize the lowest or tropical belt, which extends in the Urubamba Valley to an altitude of about 6,000 feet. From this altitude to about 11,000 feet is the intermediate belt, with maize as the principal native crop, while in the Andine belt, above 11,000 feet, the potato is the most important food plant.

In some districts wheat is grown rather extensively and is often the chief crop at altitudes between 10,000 and 12,000 feet. Barley and broad beans (*habas*) are two other European crops that are planted on a relatively large scale at high elevations. Above 12,000 feet the people are engaged chiefly with the grazing of herds of llamas, alpacas, cattle, and sheep; but potatoes and other Andine crops are planted on a small scale for the support of the pastoral population. In most places agriculture does not go much above 13,000 feet, but on some of the slopes above the Pass of La Raya potatoes are planted at altitudes above 14,000 feet. The vines make normal development and produce abundantly when planted in good soil.

Even among people of intelligence and interest in agricultural problems the superficial fact that Peru lies within the tropical zone is commonly allowed to obscure the relation of its agriculture to that of temperate regions. The fact is, of course, that in spite of the proximity



Photograph by O. F. Cook

A RECLAMATION PROJECT MADE IN PERU WHEN THE EUROPEANS PROBABLY LIVED IN CAVES

Immediately below Ollantaytambo are these broad terraces, covering more than a square mile. The soil in these terraces was assembled and put in place as carefully as for the terraces shown on page 497 (see text, page 496). The land produces a crop every year and probably has done so for centuries. In the background along the slope at the left may be seen an inclined road, where the ancient people dragged up the enormous stones to the top of the ridge above the hanging gardens shown in previous photographs.

to the Equator large areas of the plateau regions of Peru have not merely temperate climates, but conditions that could be more correctly described as cold temperate, subarctic, or alpine.

THE LESSON OF THE POTATO

In spite of having come from intertropical South America, the potato does not endure heat, but thrives at the extreme limit of agriculture in the Northern Hemisphere—Norway, Finland, Siberia, Alaska, and Newfoundland. Likewise in the Southern Hemisphere the potato was carried, even in pre-Spanish times, to the cold coast belt of Peru and Chili, and has since been taken to South Africa, Tasmania, and New Zealand (see also pages 510 and 513).

The wide utilization of the potato has proved strikingly that a plant able to grow on the high plateaus of Peru may be adapted to any of the coldest regions where agriculture is practiced in other parts of the globe, and indicates that the other domesticated plants of Peru may also be useful to all the temperate and subarctic regions of the world.

MORE PLANTS WERE DOMESTICATED IN PERU THAN IN ANY OTHER PART OF THE WORLD

It was fortunate for the rest of the world that the ancient Peruvians practiced agriculture under so wide a range of natural conditions, since this led to the domestication of a large series of crop plants. More plants appear to have been domesticated in the Peruvian region than in any other part of America. A large proportion of the cultivated species were limited to this part of the world, so that no question can be raised of their having been brought from other regions. Other kinds of crop plants used by the ancient Peruvians were widely distributed in ancient America, more especially the tropical species, those that are grown at low elevations. If these also originated in Peru, that region was responsible for by far the larger part of the American series of crop plants, more than all other parts of America taken together.

Among the more important crop plants that were cultivated by the ancient Peruvians were maize, or Indian corn, potato, sweet potato, and cassava. The following partial list of the Peruvian crop plants may give an idea of the extent and variety of domestications that were accomplished in Peru:

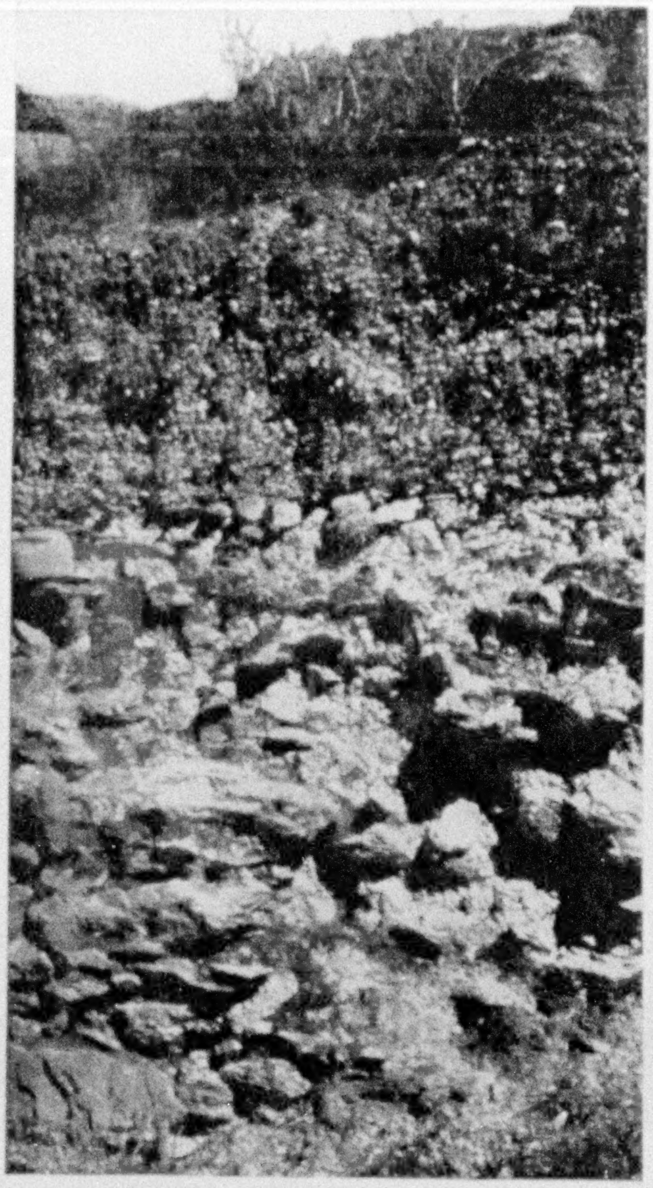
Achupalla (pineapple), *añu* (Tropæolum), *apichu* (sweet potato), *apincoya* (granadilla), *arracacha* (Arracacia), *chirimoya*, *chui* (bean), *coca* (Erythroxylum), *cumara* (sweet potato), *inchis* (peanut), *oca* (Oxalis), *pallar* (Lima bean), *papa* (potato), *papaya*, *poro* (bottle-gourd), *purutu* (frejol), *quinoa* (Chenopodium), *rocoto* (Capsicum), *rumu* (Manihot), *sahuinto* (guava), *sara* (maize), *tintin* (Tacsonia), *tomate* (Lycopersicum and Cyphomandra), *tumbo* (Tacsonia), *ullucu* (Ullucus), *uncucha* (Xanthosoma), *utcu* (cotton).

VARIETIES OF PERUVIAN CORN

A complete list of the plants that were cultivated by the ancient Peruvians has yet to be made, but it will probably include between 70 and 80 species. A large part are root crops, vegetables, and fruits, but some are seed crops, pot herbs, condiments, medicinal plants, dyes, and ornamentals. Annual plants predominate in numbers and importance, but perennials, shrubs, and trees are also well represented.

Maize, or Indian corn, is a remarkable plant, botanically as well as agriculturally. It is entirely unlike any other crop and has very few relatives in the plant world. The early explorers found corn in general cultivation in all of the agricultural areas of North and South America, but no wild form has been discovered. Where maize originated is still a question. Some writers have favored Mexico and others Peru. The relative importance of maize was greater, no doubt, in Mexico, where not so many other plants were cultivated as in Peru. Another reason for associating maize with Mexico is the occurrence of the grass called teosinte, which crosses readily with maize and was formerly believed to represent the ancestral form.

That the cultivation of corn goes very far back in Peru is indicated not only by the abundance of specimens found in the



Photograph by O. F. Cook

A CROSS-SECTION OF A TERRACE

This part of a ruined terrace shows how the gardens were constructed. At this point the retaining wall had been carried away, except a little at the lower left-hand corner, thus exposing the material behind the wall and allowing its arrangement to be seen. Two distinct strata are apparent, coarse stones and clay below, with fine agricultural soil above.

ancient graves, but by the fact that the type of maize that furnishes the bulk of the Peruvian crop is peculiar to that region. The question is not merely of varieties, which are very numerous in both continents, but of a whole series of varieties very unlike any that are known from Central America or Mexico.

This Peruvian maize, or Cuzco corn, as it has been called in the United States, is characterized by the very large kernels, some of them nearly an inch broad, almost the size of chestnuts. The large kernels are an advantage from the standpoint of the natives of Peru, who are accustomed to eating corn a kernel at a time. The usual method of cooking corn, and everything else in Peru, is by boiling, the reason being probably that more fuel would be required for roasting or parching. Fuel is very scarce and expensive in all of the populous districts of Peru.

PERUVIAN CORN MAY HELP US

In the United States the large kernels would be of less importance, but the Peruvian type of maize may prove interesting in another way. The fact that the Cuzco corn is the only type grown extensively on the high slopes and tablelands may mean that it is more suited to cool climates than other sorts of maize. The large kernels have attracted the attention of travelers, and numerous attempts have been made to introduce the Cuzco corn into the United States. Bayard Taylor raised a few plants in Pennsylvania as far back as 1865 from seeds brought home by Squier, the well-known writer on Peru.* Such experiments with the Cuzco corn in the United States have given a completely misleading impression regarding the habits of the plant.

The usual behavior of the Cuzco corn in the United States is to produce plants of enormous size that mature very little seed, often none at all. It has been taken for granted that the size of the plants should be in proportion to the enormous kernels, and that our seasons were not long enough to permit this type of corn to mature.

But in Peru one does not see these gigantic, infertile plants, nor any indication that the corn crop requires a large amount of heat to bring it to maturity. The impression one gets from the Peruvian corn-fields is that the plants are not taller than with us and rather more slender, the most striking peculiarity being the prevailing red color of the foliage. The best development and largest ears of the Cuzco corn are found in some of the higher valleys, at elevations between 9,000 and 11,000 feet, in districts where the summer climate is cooler than in any of the corn-growing regions of the United States.

Thus it becomes apparent that the possibility of utilizing the Cuzco type of corn in the United States is still practically un-

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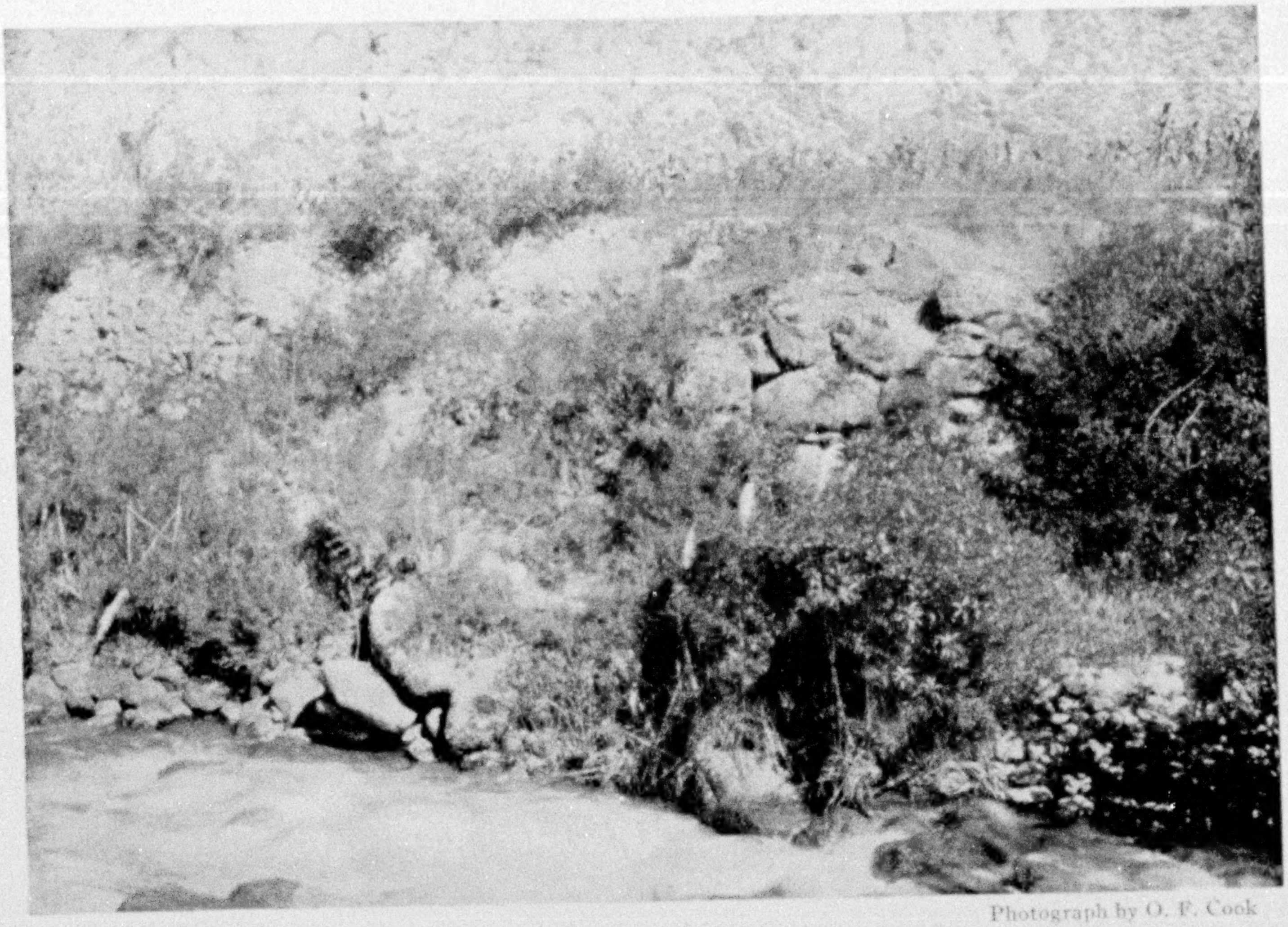
**American Agriculturist*, 40:9, January, 1881.



Photograph by O. F. Cook

ANOTHER ILLUSTRATION TO SHOW THAT THE SOIL AND SUBSOIL OF THE TERRACES WERE PLACED AS LABORIOUSLY AND CAREFULLY AS THE WALL ITSELF

The structure of a large agricultural terrace exposed along the stream near the middle of the valley, seen in the photograph on page 506, shows that these broad terraces are as truly artificial as the narrow ones on the slopes. A part of the old retaining wall that protected the terrace from the stream is still in place at the right, while the naked bank at the left has the same arrangement of fine soil above and loose stones for subsoil as the narrow terraces of the hanging gardens (see text, page 496).

tried, because of our lack of information regarding the normal behavior of the plant and the natural conditions to which it is adapted. As might have been expected, if these facts had been known, the best results thus far obtained from the Cuzco corn in the United States have been in California, in the cool climate of the coast districts, where there is too little heat for our eastern varieties to thrive.

Thus the first step in determining the possibilities of acclimatizing and adapting South American varieties of corn to use in the United States is to place them under conditions where the plants can behave in a normal manner and mature seed. In experiments conducted last year near the coast of southern California all of the varieties from Peru and other table-land regions of tropical America were able to mature seeds, which many of them had failed to do when planted in the Eastern and Southern States.

A CORN THAT GROWS AT AN ELEVATION OF 13,000 FEET

The cultivation of corn in a cool climate has been pushed to an extreme limit on the high plateaus around Lake Titicaca, where a dwarf form of corn is planted at an elevation of nearly 13,000 feet. The specialized nature of this variety became apparent in the experiments near San Diego, where it matured in less time than any other, or in about 60 days. Worthless as it would appear from the insignificant nubbins that we purchased from the Indian women in the market of Copacabana (page 523), this dwarf table-land form is distinctly of interest as an example of a variety with much lower heat requirements than those we now

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have, which shows a possibility of extending the range of the corn crop in the United States.

In the tropical portions of the lower valleys of the eastern Andes the Cuzco type of maize gives place to another with larger ears and smaller kernels, much more similar to the Mexican and Central American varieties, or to those that are cultivated in the United States. If maize originated in the Peruvian region, it would be easy to understand that the varieties grown at the lower elevations would be much more likely to spread to North America than the varieties that are confined to the cool table-lands.

The existence of the specialized high altitude types of maize in Peru may be taken to indicate either a very long period of adaptation to the high altitudes or a possible origin of maize as a high-altitude plant. Whether the course of adaptation has been upward or downward, the success of the process is very significant of the possibilities of much wider utilization of maize in cool regions than has been considered possible in the past.

Maize is not a staple crop at very high altitudes. Above 12,000 feet it is raised in only a few places, not as a regular food, but rather as a luxury for making the native beer, or *chicha.* To take the place of maize, the natives of the elevated districts use plants that are closely related to one of our common weeds, called "pigweed" or "lamb's-quarters."

PIGWEEDS FOR OATMEAL

Two species of pigweeds are regularly grown in the valleys that lead up to the Pass of La Raya, between Cuzco and Lake Titicaca. The large species, which often attains a height of 3 or 4 feet, is called *quinoa,* while the small species, seldom more than a foot high and often only 5 or 6 inches, is called *cañihua.* In general appearance both species are much like our pigweed, but they are regularly planted and harvested by the Peruvians, and are in fact the only seed crops grown in the elevated districts that are too cold for maize.

Considering *quinoa* as a high-altitude substitute for maize means that it is valued chiefly for making beer, and in some districts most of the crop is used in this way. Only the white-seeded variety of *quinoa* is considered suitable for eating, the others being very bitter, so that they have to be boiled, with several changes of water, in order to be made palatable. The white *quinoa* makes an excellent breakfast food, fairly comparable with oatmeal, and likely to be preferred by many, both for the taste and texture. The seeds become soft with cooking, but retain their form, and do not appear so slimy as oatmeal when treated in a similar manner. The leaves of *quinoa* are also cooked and eaten as a pot-herb.

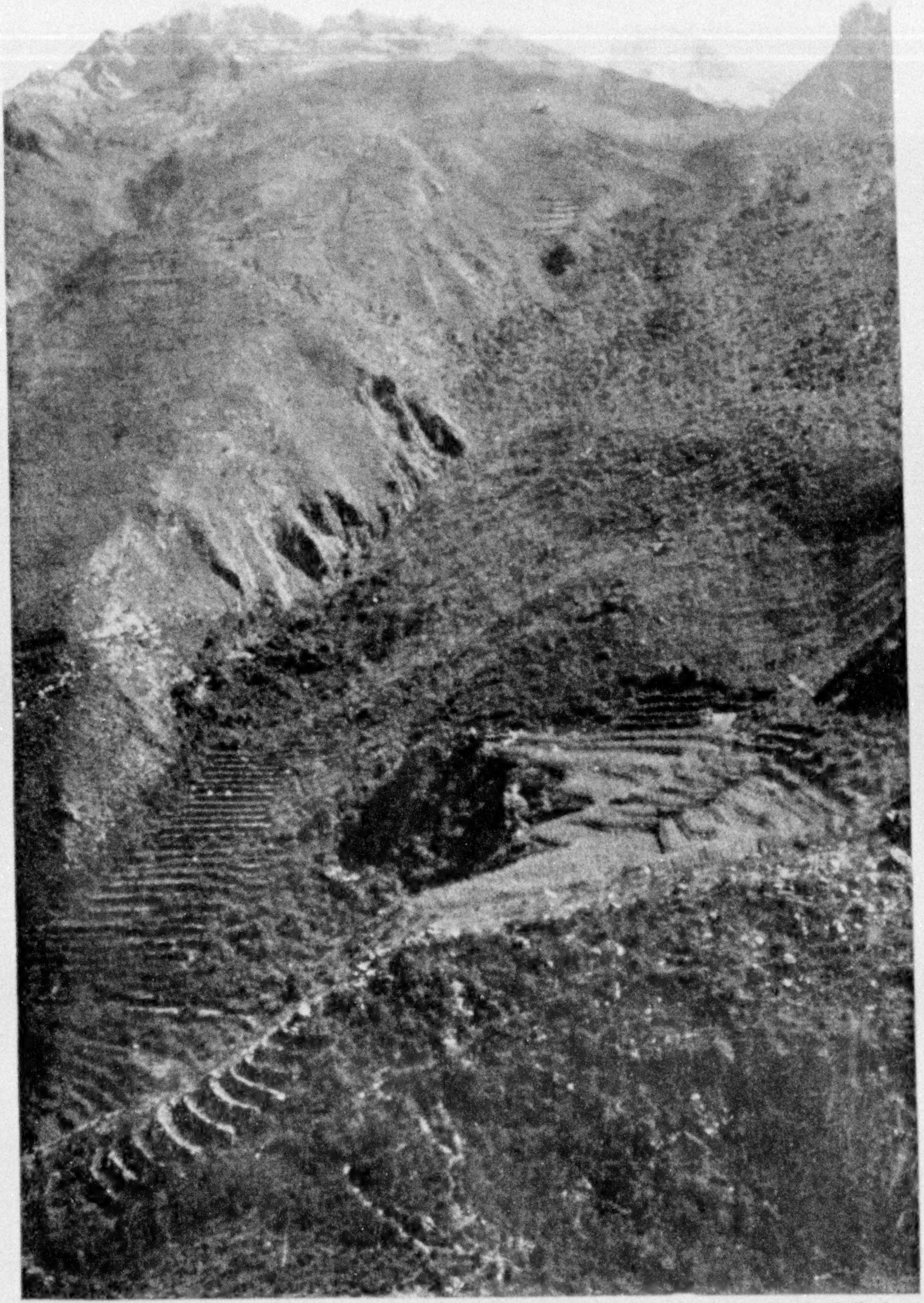
The other pigweed crop, *cañihua,* is raised altogether for food. The seeds are much smaller than those of *quinoa* and of a grayish color in the mass. They are parched slightly and ground into a fine flour. The chief use of *cañihua* is as a travel ration for the shepherds who go out on the high plateaus with their flocks of llamas, alpacas, and sheep.

THE TREASURE OF THE INCAS

The gold of the Indies was the attraction that led Columbus to sail westward, that carried Cortez to Mexico and Pizarro to Peru. The Incas had large stores of the precious metal, representing, no doubt, the accumulations of many centuries. The capture of such a booty resounded through Europe. Spain became for a time the wealthiest, as well as the most powerful, nation of Europe, and this was ascribed to the gold of Peru.

But Peru held another treasure much more valuable for the nations of Europe than the golden booty of Pizarro. Carrying the potato to Europe was an event of much more profound significance in relation to the subsequent history of the world than sending the Inca gold to the coffers of Spain. But nobody understood the value of the potato, and its Peruvian origin was generally forgotten before the plant became well known. Instead of Peruvian potatoes, we call them Irish potatoes.

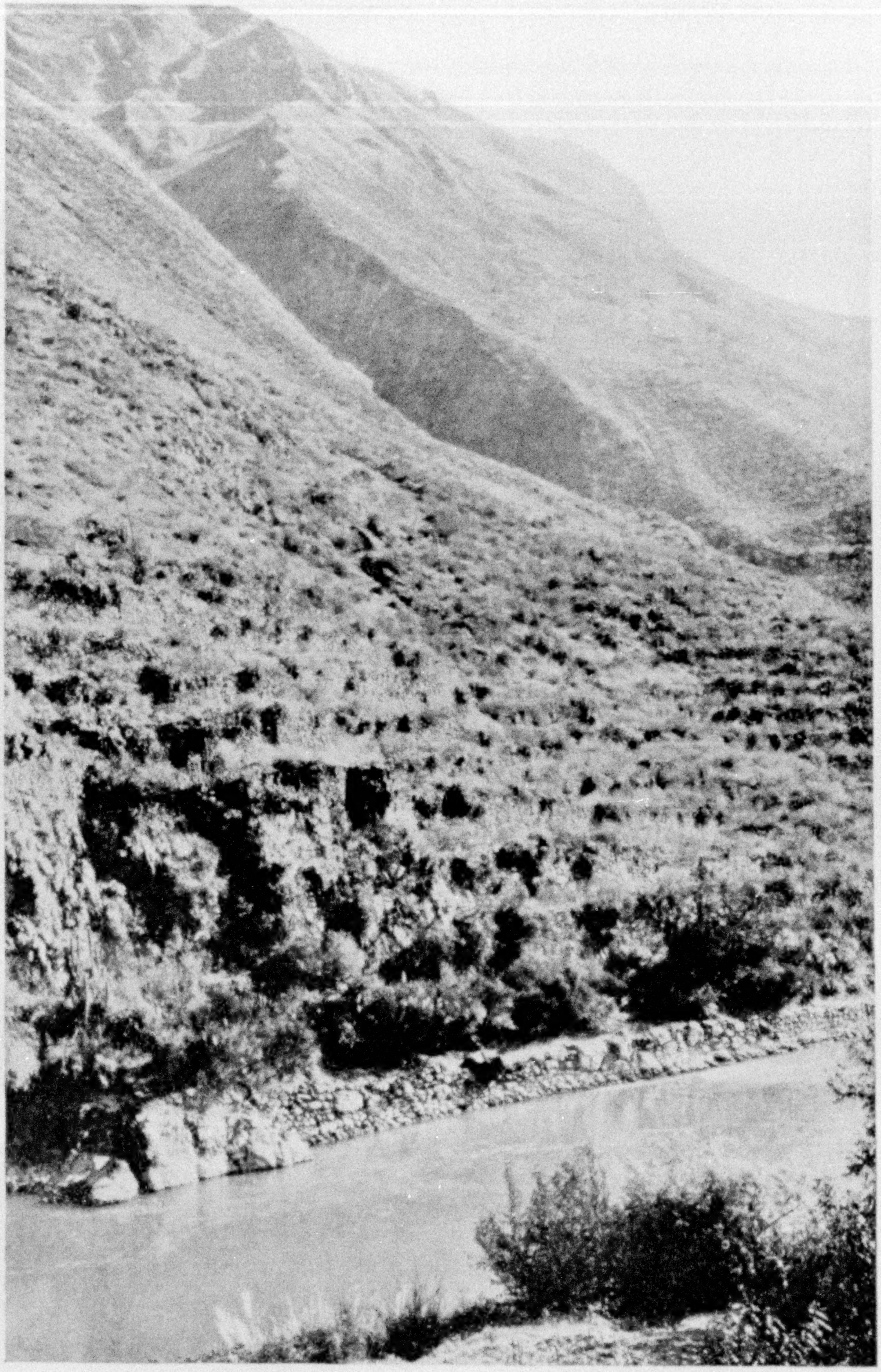
The potato was the basis of the ancient Peruvian nation and has attained almost the same importance in other parts of the world within the last hundred years.



Photograph by O. F. Cook

TERRACES REACHING ALMOST TO THE SNOW

Not only the terraces, but all of the higher slopes, appear to have raised crops in ancient times, and cultivation continues in a few places that can be distinguished near the top of the ridge. The broken slope near the middle of the photograph is on the side of a deep ravine filled with a dense forest, which is spreading gradually over the neighboring slopes (see page 500).



Photograph by O. F. Cook

THE URUBAMBA RIVER OPPOSITE OLLANTAYTAMBO

An ancient retaining wall still protects a bank of terraces along the base of the steep southern slope of the valley. The terraces are overgrown with tara trees (*Cæsalpinia pectinata*), pinco pinco (*Ephedra*), chuchao (*Fourcroya*), and several species of cacti.

The instinctive prejudice against new food plants prevented any general utilization of the potato in Europe for over two centuries, and it did not begin to be grown as a crop until the period of the French Revolution. Even then it had to be forced on the public by the persistent efforts of the French philanthropist, Parmentier, who demonstrated its food possibilities by establishing a large number of soup kitchens for the poor of Paris. Potato soup still bears the name Parmentier—a homely memorial, but one that might not be ungrateful to a philanthropist.

Historically speaking, the general utilization of the potato is still relatively recent. Less than a century ago it was still considered as something of a novelty among the farmers of the United States. Thus, in 1856, we find in the *American Agriculturist* the following statement:

"I have worked a farm over fifty years, and have cultivated potatoes more or less every year. Fifty years ago little was thought of this root. A row or two were planted on the outside of corn-fields, or in some corner of a lot unfit for anything else. Ten to fifteen bushels was an ample supply for a family. There is a great difference between then and now as regards this crop, for potatoes are now one of the most important branches of agriculture" (Vol. 15, p. 256).

Contrast with this statement the fact that about 400,000,000 bushels of potatoes are produced annually in the United States. The world's crop of potatoes must be more than 6,000,000,000 bushels. The statistics of production for 1912 showed 5,931,493,000 bushels, but included no returns for the ancient centers of production in the table-land regions of Peru, Bolivia, Ecuador, Colombia, and Venezuela, nor for Central America or Mexico. As the potato-growing districts are the chief centers of population in all these countries, many millions of bushels must be produced by them.

The world total of six billion bushels means that if the potato crop of the world were to be divided equally, there would be enough to give each inhabitant of the earth about four bushels of potatoes. *The value of a single potato crop probably much exceeds that of all the gold that the conquerors took from the Incas.*

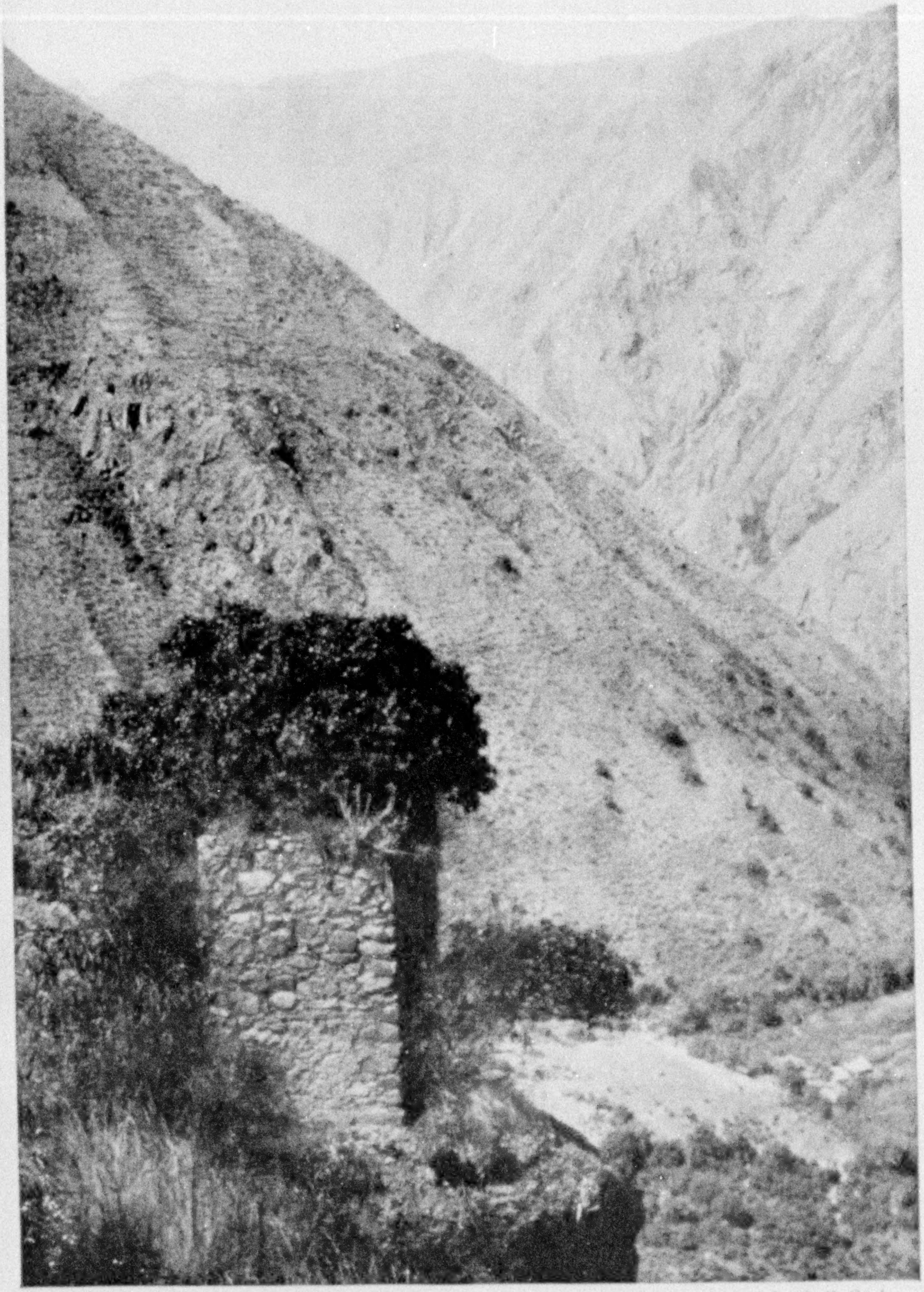
THE HOME OF THE POTATO CAN GIVE US OTHER VALUABLE FOODS

As the home of the potato, Peru may be looked upon as the source or fountain head from which must come new stocks to strengthen and maintain the varieties of this great food staple. Just as continued importation of live-stock breeds is necessary to renew our American strains, it is now beginning to be urged that new and vigorous varieties of potatoes be found to offset the gradually waning virility of old and run-out stocks.

Other possibilities lie in the direction of securing varieties that are really superior to any that we now have. Notwithstanding the enormous importance that has been attained by the potato in the agriculture of Europe and the United States, no adequate attempt has been made to secure the best forms for our use.

Peru has many kinds of potatoes superior in quality to those that we cultivate, but most of them would not be considered promising with us, because the tubers would be hard to peel on account of irregular form and very deep eyes (page 524). Breeders of potato varieties have been influenced very largely by the size and form of the tubers, with quality and flavor left largely out of account. But, with such an infinity of forms to draw upon in South America, it should be possible to combine all of the desirable features. Some of the Peruvian varieties are almost ideal in form (page 524).

It seems very strange, in view of the importance attained by the potato, that there should not have been a more general appreciation of this and the other plant treasures that South America has bestowed upon the other continents. Not only the Peruvian varieties of potatoes, but many of the agricultural plants of Peru, are still entirely unknown in other countries. Much less has there been any systematic effort to gain what might be described as an agricultural cognizance of these treasures — that is, a practical knowledge of the nature, habits, and uses



Photograph by O. F. Cook

FARMING AT AN ANGLE OF 45 DEGREES

A slope in the valley of Ollantaytambo, with an angle of about 45 degrees, or steeper than the roofs of most houses, is covered with transverse ridges, showing that the entire surface was cultivated in former times. Parts of the same slope farther to the left are still cultivated. The structures in the foreground are ancient graves or storehouses, perched on a large rock, seen from a ruined town called Pumamarca.

of the plants. Of some of them even botanical information is lacking. Indeed, it may be said that knowledge of some of these plants has actually declined since the time of the conquest.

The account of Peruvian economic plants written by Padre Cobo less than 70 years after the conquest is still the most extensive and detailed work on the subject.

OTHER PERUVIAN ROOT CROPS

The agriculture of Peru is based on root crops, primarily. Seed crops are relatively few, and, with the exception of corn, are almost incidental to the numerous root crops. Even corn is used largely for making *chicha* rather than for food, especially in many districts at higher elevations, where potatoes are the chief article of diet.

In order to understand the domestication of many root crops in Peru, it is necessary to go back to a pre-agricultural or an extremely primitive agricultural state, when people subsisted entirely or very largely upon wild roots, and resorted every year to the gathering of these, instead of being able to rely entirely upon the products of cultivated land, as in a more advanced state of agricultural development. With agriculture developed to the point of complete independence of the wild-food materials, no more domestications of food plants are likely to be made, as none seem to have been made during the entire historical period of civilized European agriculture.

From eating a great number of plants, as the wandering savages do, agricultural man gradually becomes restricted by habit to the foods that are produced by cultivation, and he finally reaches a stage where the idea of going out and bringing in a wild plant to cultivate as food is entirely foreign to the mind. To the present-day Indians of Peru the cultivated food plants represent a perfectly distinct and definite class. The plants that are sown are sown, and the plants that are wild are wild. They accept as a matter of course that there are wild potatoes, wild ocas, wild añus, wild arracachas, wild achiras, and so on down the list; but it is not supposed that these have anything to do with the cultivated forms of the same types, or that anybody would be foolish enough to plant the wild kinds and expect to raise crops from them.

If any more plants are domesticated in Peru, the Indians are not likely to do it—that is, for their own use. If some new crop should be introduced by the white people, or if a demand should arise for the product of a wild plant that could be cultivated easily, the Indians might go to planting it, for their agricultural habits and instincts are highly developed; but either of these contingencies is very different from a spontaneous domestication of a new native food plant on their own initiative and for their own use.

In the alpine or Andine belt, where the potato is the chief crop, three other root crops are generally grown, by the same methods and often in the same rows with the potatoes. These Andine root crops are the oca (*Oxalis tuberosa*), the añu (*Tropæolum tuberosum*, page 526), and the ullucu (*Ullucus tuberosus*). The tubers of all of these plants are remarkably alike and similar to some of the varieties of potatoes, although the plants have no relation to potatoes or to each other. The *oca* is a relative of our sheep sorrel, the *añu* of the common flowering nasturtium, and the *ullucu* of the Madeira vine. Though not attaining the size of large potatoes, the other tubers are more attractive in appearance and seem to have even better keeping qualities.

The possibility of utilizing them in the cooler parts of the United States is worthy of careful consideration. Their value might lie, as in Peru, in supplementing the potato, and thus affording a more varied vegetable diet. They yield well and are easily grown. Though natives of a tropical country, these crops are found only in the cool elevated districts and are, like the potato, intolerant of high temperatures.

In the lower part of the potato belt there is another root crop—the *yacon* or *llacon* (*Polymnia sonchifolia*)—comparable to the so-called "Jerusalem" artichoke, which is supposed to be a native of Mexico. It produces large, compact clusters of thick, fleshy roots tapering at both ends and with a strong external re-

XUM

semblance to sweet potatoes. The flesh is crisp, juicy, and has a pleasant, sweetish flavor, rather better than that of the Jerusalem artichoke. The *yacon* and *ajipa* (*Cacara*) are eaten raw, while all other root crops are cooked.

At elevations below 6,000 feet another series of root crops is grown, consisting of numerous varieties of *rumu* (Manihot), *uncucha* (Xanthosoma), *apichu* and *cumara* (two types of sweet potatoes), *achira* (Canna), and *unguna* (Curcuma).

THE HARVESTING, STORAGE, AND DISPOSITION OF THE CROPS WERE DIRECTED BY THE GOVERNMENT

According to the early Spanish historians, the Incas had complete control of the land and of all of the agricultural activities of the people, from the planting of the seed to the harvesting, storage, and disposition of the crops. An extensive system of public storehouses was maintained, not only at the chief centers of population, but along all of the principal routes of travel and in the high passes between the valleys.

A complete system of accounts was kept by means of *quipus*, or knotted cords, with different kinds and colors of knots to represent different quantities and classes of objects. The system of public accounting was used not only to determine the taxes or contributions to the government, but as a practical form of insurance, a failure or deficiency of crops in one section being made good from other parts of the country, where more abundant harvests had been secured. When the country was devastated at the time of the Spanish conquest the same system of making good the local losses was employed, "in order that all might not be devastated," as we learn from the account of Cieza de Leon,* written probably about 1550:

"So it was arranged, and as soon as the Spaniards were gone the chiefs assembled, the *quipus* were examined and checked, and if one province had lost more than another, that which had suffered less made up the difference; so that the burden was shared equally by all. To this day these accounts are kept in each valley, and there are always as many accountants as there are lords, and every four months the accounts are made up and balanced."

In like manner it is apparent from the accounts of the early historians that the recognized object of the religious system was to secure favorable conditions for the growth of the crops. Like many other primitive peoples, the Incas had a system of sacrifices or offerings to secure the favor of the gods. Though not a cruel or bloodthirsty people like the Aztecs, whose sanguinary deities required a continual butchery of captives, there is no longer any doubt that the Incas also had a system of human sacrifices to secure the favor of the deity for the Inca and his people. A special religious caste of vestals or Virgins of the Sun was maintained at some of the chief religious centers, and numerous burials of strangled women have been reported by Uhle at the great temple of Pachacamac, near the coast south of Lima. The object of these sacrifices, as stated in a passage quoted by Uhle from Molina, was "that the Creator might grant the Inca victory, health, and peace."

How thoroughly ingrained and instinctive the Inca system was may be best understood from the extent to which it still persists, nearly four centuries after the conquest. The need of "paying the Incas," in order to be assured of good crops and natural increase of the flocks, is still felt by thousands of the rural Indians and manifested in many ways. In the native markets of all of the larger towns there is an extensive trade in medicinal and aromatic plants, the chief use of which is for burnt offerings to the Incas to avoid the risk of offending them and thus inviting injury or loss.

Other curious survivals of the ancient system are seen in the little images of metal, clay, or stone which are buried in the ground for the benefit of the crops. At Cuzco minute images are made of metal, but at La Paz the same purpose is served by carved stones, called *mullo*

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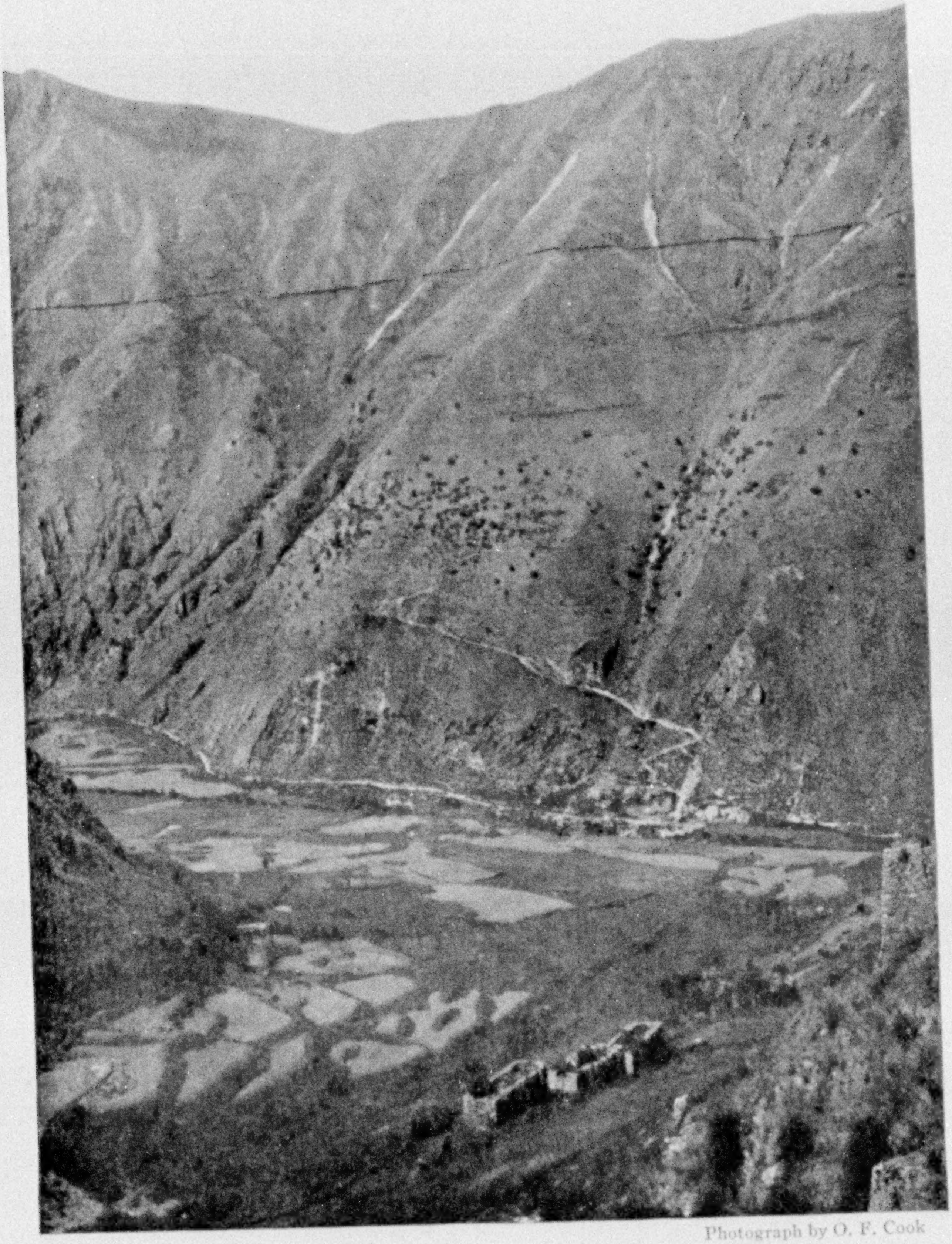
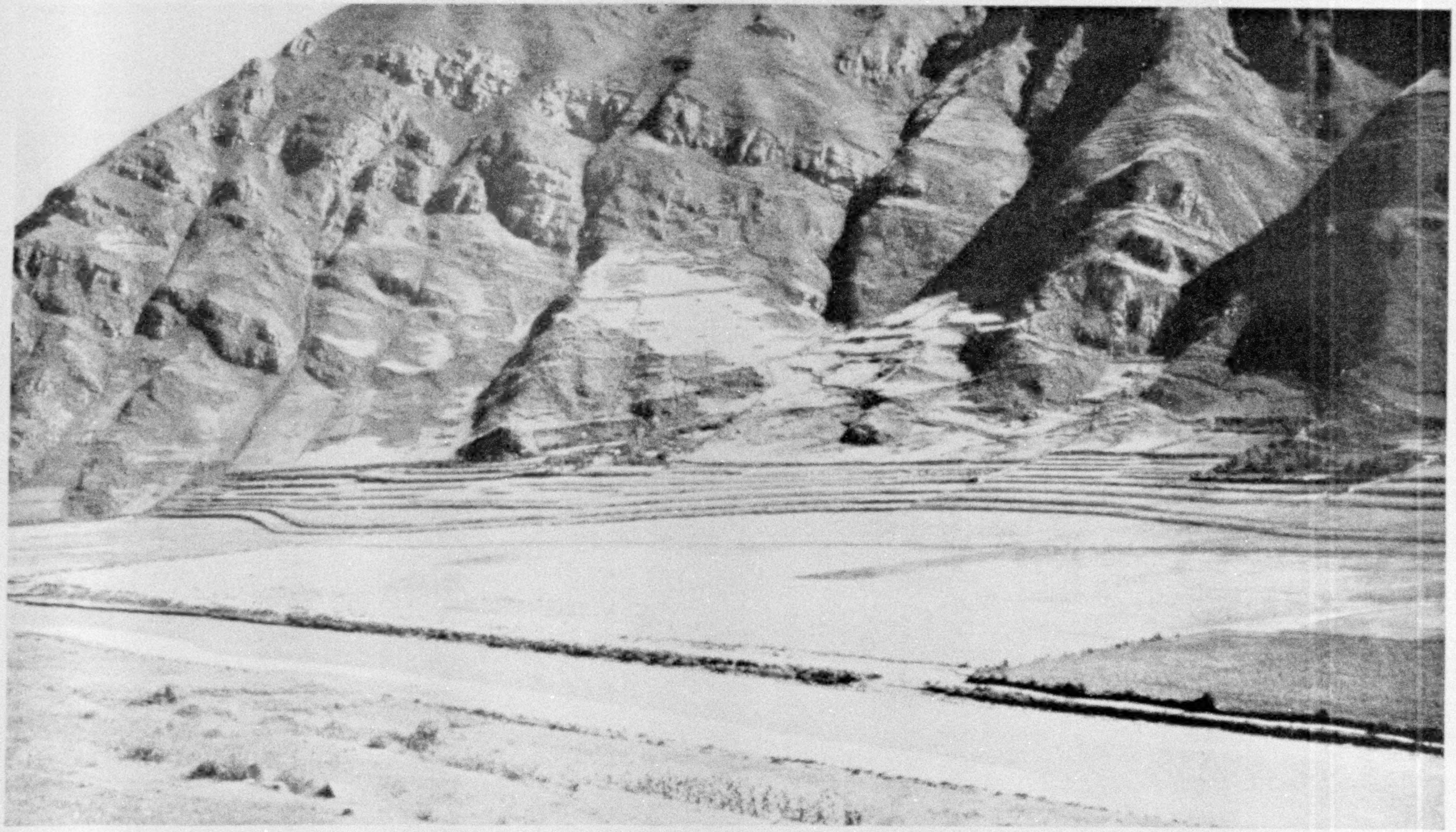
* Cieza de Leon, Pedro de. Second part, Chronicle of Peru, translated by Clements R. Markham, London, 1883, pages 34-35. Hakluyt Ed.



Photograph by O. F. Cook

THE COURSE OF AN ANCIENT AQUEDUCT

The indistinct dark line that crosses the high slope, shown about two inches below the top of the photograph, represents the course of an ancient aqueduct carried for many miles along a mountain wall hundreds of feet above the valley. In the foreground, near the ruined town of Pumamarca, is a group of Inca storehouses. The stream in the bottom of the valley is carried in a straight course along the farther side of the valley bottom. Note canals cutting across mountains (see text, page 498).



Photograph by O. F. Cook

ARTIFICIAL LANDS ALONG THE URUBAMBA RIVER BELOW PISAC

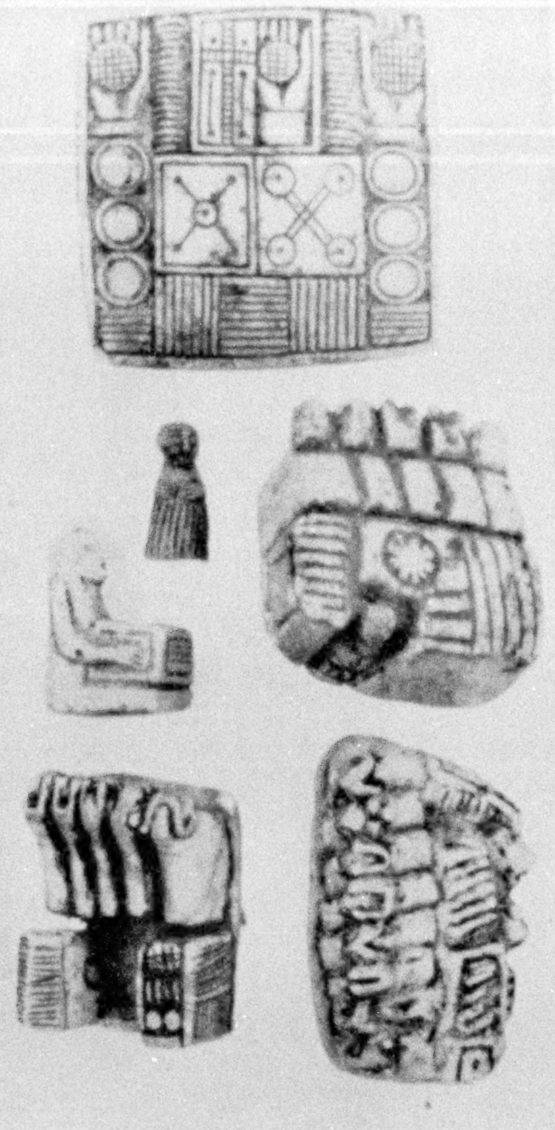
For about a mile the river has been confined by walls to a straight channel and the land leveled to the base of the slope where narrower terraces were built, the first two with broad, sweeping curves (see page 497).

or *piedras de Charasani.* These are still used and sold regularly in the native markets by the dealers in medicines and aromatic drugs. These curious sculptures take the form of small models of fields and farmsteads, with rows of sheep and cattle. They remind one of the colonnades of bulls in Egypt, which may have been constructed for the benefit of the animal industry of the Empire of the Pharaohs.

DESTRUCTION OF THE INCA SYSTEM

Agriculture was a fundamentally important step in the development of civilization, because it constituted the discovery of a way to live and let others live, too. As long as primitive man remained dependent upon game or natural products there was seldom enough to go around. The natural attitude of non-agricultural tribes roaming about in search of food is to fight all strangers on sight, and this attitude persists in many nations that have adopted agriculture as an art, but are not yet converted to it as an ideal or philosophy of existence.

Dominance of the predatory instinct is seen when people would rather raid the harvests of others than raise crops of their own. How thoroughly agricultural were the ancient Peruvians in habits and instincts is evidenced by their greater freedom from the predatory instincts in comparison with our European race. In this respect the Incas were admittedly superior. Several of the early historians give testimony to this aspect of the Inca civilization. Cieza de Leon and other thoughtful men among the conquerors saw very clearly that something had been destroyed that could not be replaced.

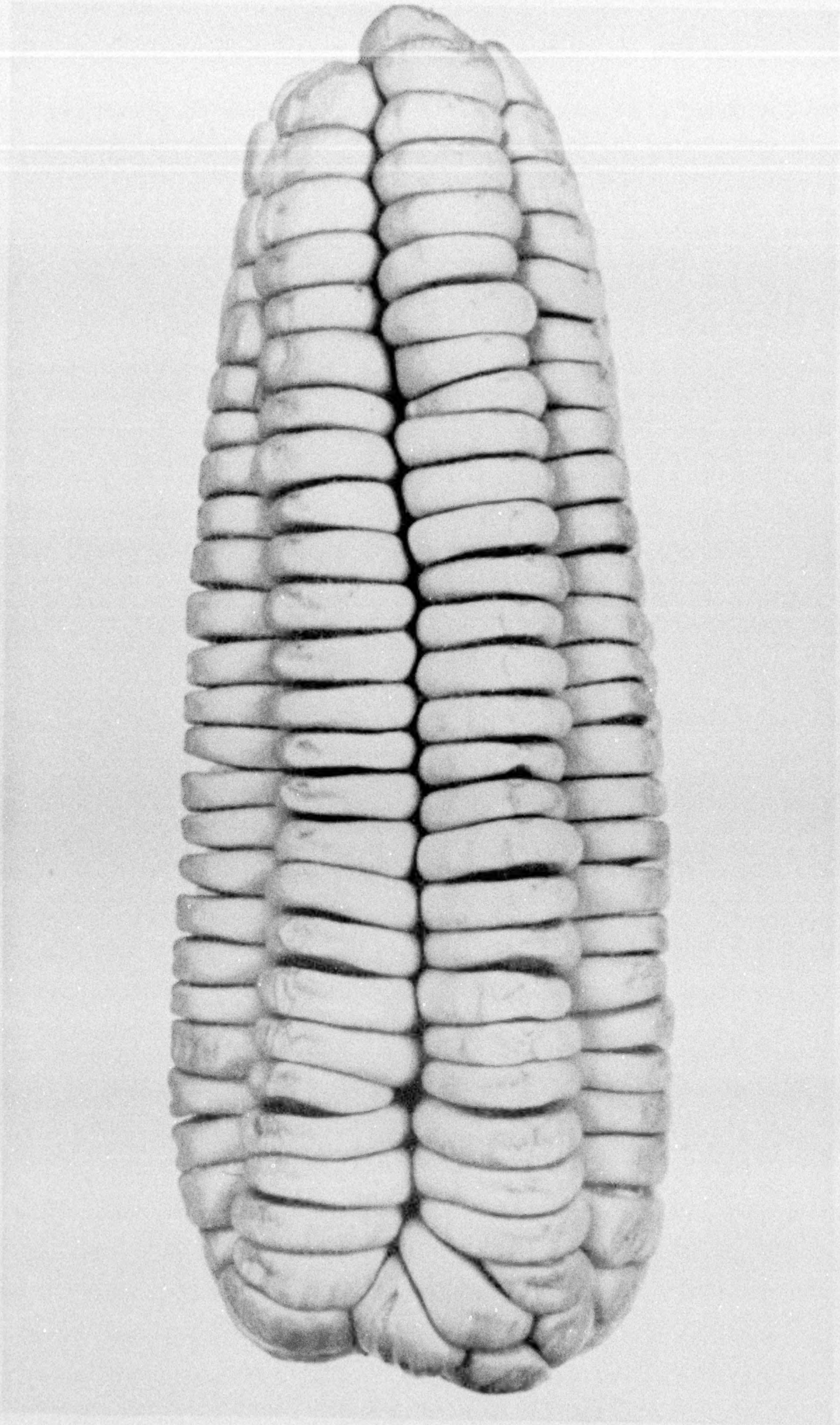


Photograph by O. F. Cook

INSURING AGRICULTURAL PROSPERITY

The rural Indians of Peru still believe in "paying the Incas", for fear that their crops will fail if the ancient observances are neglected. Burnt offerings of drugs and aromatic plants are still made and small images buried in the fields for the benefit of the crops and herds. Such are the stone carvings, called *mullo*, or *piedras de Charasani,* that are still sold in the native market of La Paz, Bolivia, shown in actual size in this photograph. Some of the carvings represent wives, boxes of money, or money in the hand; but most of them are definitely agricultural, showing potato fields, grain fields with irrigation channels, stacks, barns, and ranks of sheep or cattle, like the colonnades of bulls in ancient Egypt.

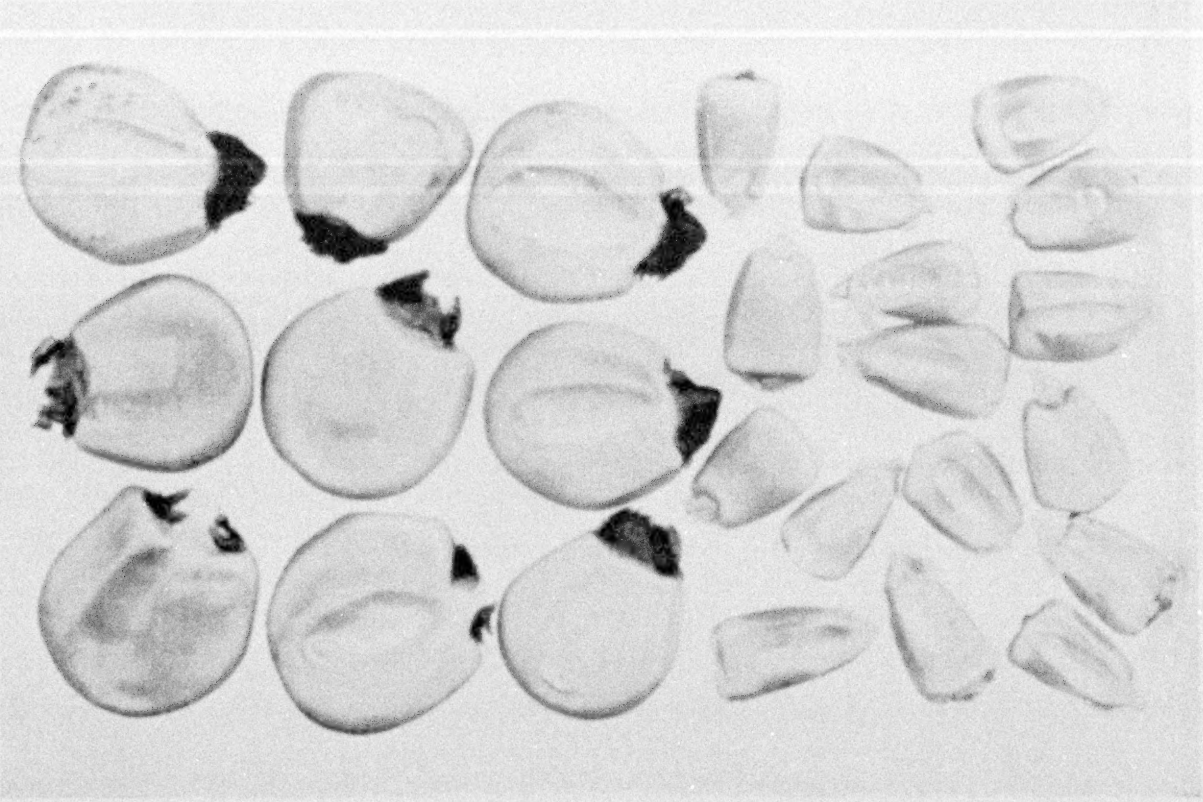
The most convincing testimony was given by one of the soldiers who came with Pizarro, the last survivor, he tells us, of the original band, who had the best opportunity of knowing what the Inca organization was before the conquest; and after all of his companions were gone, the idea of regret and remorse for the destruction that had been wrought grew in the mind of this aged warrior. He cast about for a way to discharge his conscience by telling the King of Spain the truth about the Inca civilization. He knew that the king's ear had been sought by many adventurers, who carried tales of wrongs to the Indians as a means of securing their own advantage, and that others had countered with tales of barbarous practices among the Indians, some of them fabricated and others carried over from the savage tribes of other parts of America. Also the truth was bitter, and the king might not hear it willingly; certainly nobody who hoped



Photograph by O. F. Cook

CUZCO, THE LARGE-KERNEL CORN OF PERU

In the middle farming zone of Peru, at elevations between 8,000 and 11,000 feet, the Cuzco type of corn is the principal crop. It is characterized by very large kernels, sometimes nearly an inch broad. Cuzco is native to the cool tablelands of Peru rather than the tropical valleys. This fact throws new light on its behavior in the United States. In the hot summer climate of the eastern States it usually fails to set seed, but it may be of use on the Pacific coast or other parts of the United States where there is too little heat for our varieties to mature (natural size).



Photograph by O. F. Cook

THE LARGE CUZCO KERNELS ARE EATEN ONE BY ONE

The huge size of the Cuzco kernels (shown on the left) is more apparent when compared with the kernels of Boone County white, one of our popular varieties (shown on the right). The large kernels are eaten one at a time in Peru, like grapes or chestnuts. The meat slips out of the skin when the boiled kernel is pressed between the thumb and finger. Ripe corn is eaten this way, as well as green corn, and is a staple article of diet among the Indians, who call it *moti* (natural size).

for royal favor would undertake to deliver such a message.

AN IRREPARABLE LOSS

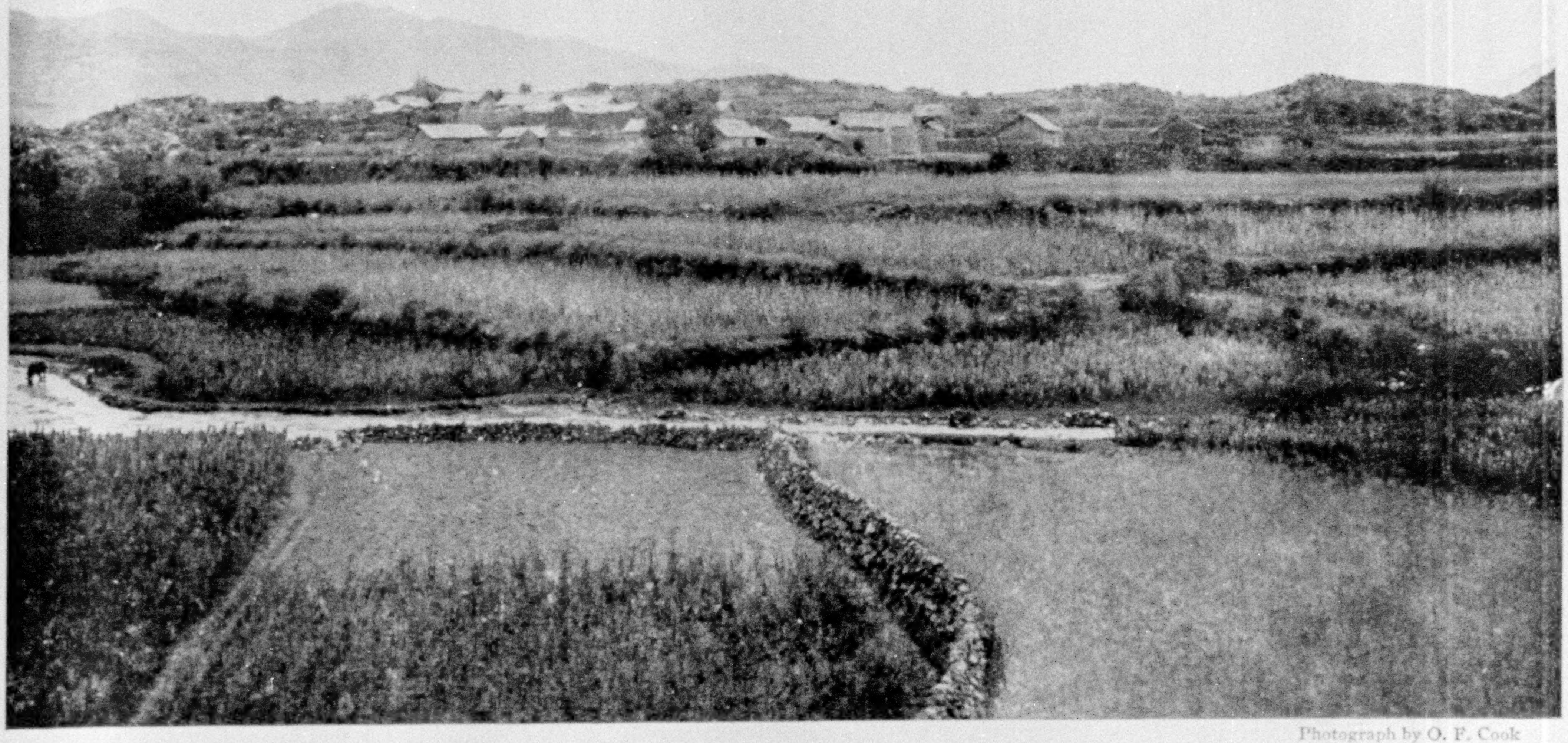
The problem was not easy; but the aged warrior had a resourceful mind as well as an active conscience, and he found a way to give his testimony a lasting record. Instead of setting out on a vain journey to the court of Spain, he waited quietly at Cuzco and let death deliver his message to the king. As the last of the conquistadores, he claimed the right to send the king a legacy of truth regarding the Incas:

> "True confession and protestation in the hour of death by one of the first Spaniards, conquerors of Peru, named Marcio Serra de Lejesama, with his will proved in the city of Cuzco on the 15th of November, 1589, before Geronimo Sanchez de Quesada, public notary.

"First, before beginning my will, I declare that I have desired much to give notice to his Catholic Majesty King Philip, our lord, seeing how good a Catholic and Christian he is, and how zealous in the service of the Lord our God, concerning that which I would relieve my mind of, by reason of having taken part in the discovery and conquest of these countries, which we took from the Lords Yncas, and placed under the royal crown, a fact which is known to his Catholic Majesty.

"The said Yncas governed in such a way that in all the land neither a thief, nor a vicious man, nor a bad, dishonest woman was known. The men all had honest and profitable employment. The woods, and mines, and all kinds of property were so divided that each man knew what belonged to him, and there were no lawsuits. The Yncas were feared, obeyed, and respected by their subjects, as a race very capable of governing; but we took away their land, and placed it under the crown of Spain, and made them subjects.

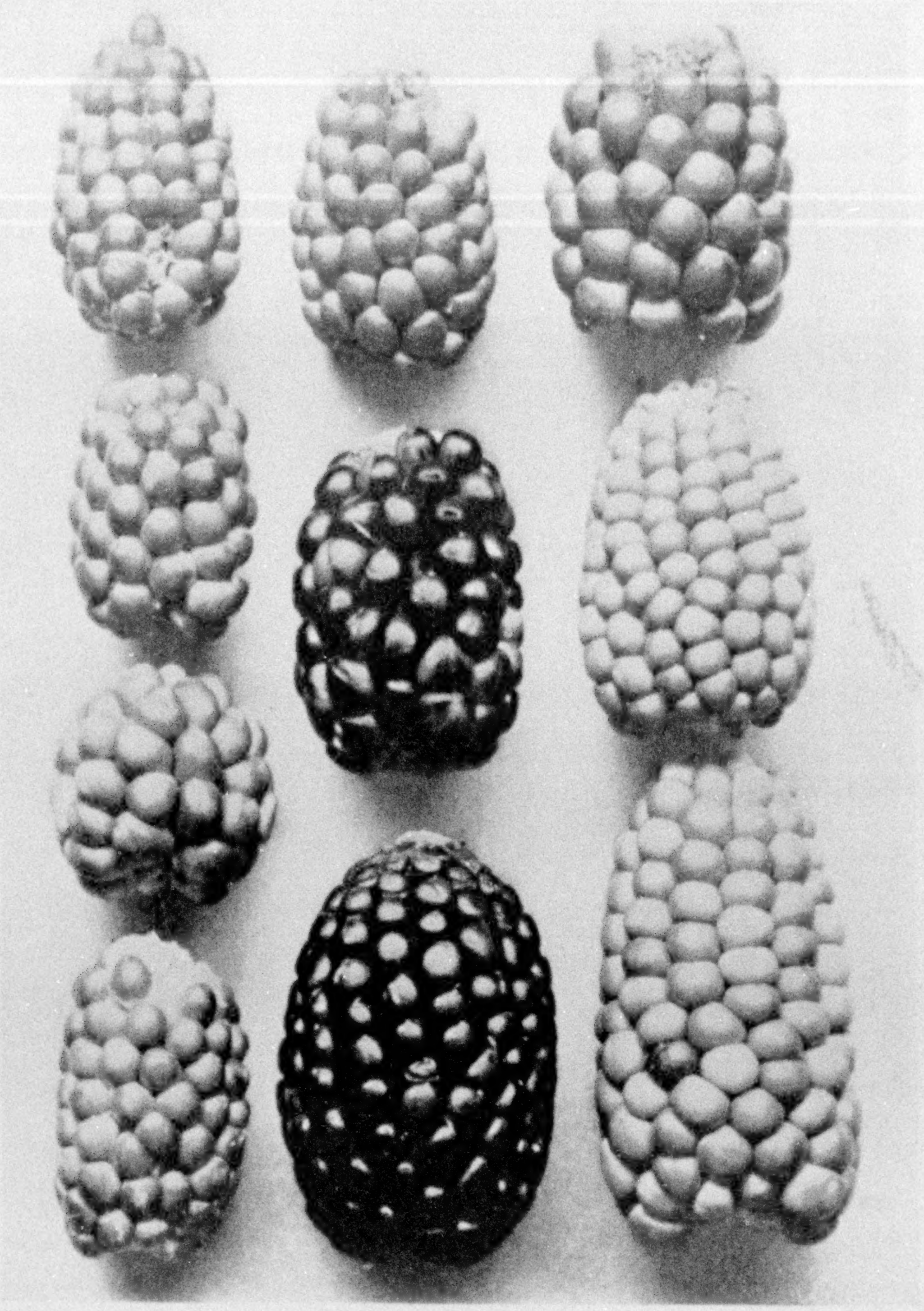
"Your Majesty must understand that my reason for making this statement is to relieve my conscience, for we have destroyed this people by our bad examples. Crimes were once so little known among them that an Indian with one hundred thousand pieces of gold and silver in his house, left it open, only placing a little stick across the door, as the sign that the master was out, and nobody went in. But when they saw that we placed locks and keys on our doors, they understood that it was from fear of thieves, and when they saw that we had thieves amongst us, they despised us. All this I tell your Majesty, to discharge my conscience of a weight, that I may no longer be a party to these things. And I pray God to pardon me, for I am the last to die of all the discoverers and conquerors, as it is notorious



Photograph by O. F. Cook

AGRICULTURE IS STILL PRACTICED INTENSIVELY HERE

These terraces, of rather irregular form, are in a thickly inhabited district about the temple of Viracocha, near Tinta, in the Vilcanota Valley, at an altitude of about 11,000 feet



Photograph by O. F. Cook

PIGMY CORN OF THE HIGHEST ALTITUDES, PICTURED SEVEN-EIGHTHS NATURAL SIZE

The culture of maize is carried to its extreme limit in a few places on the islands and slopes around Lake Titicaca, at an elevation of nearly 13,000 feet. The diminutive ears were bought in the market at Copacabana, on the south shore of the lake, where a great fair is held annually, near the end of the winter season, in August. In a planting of this type of corn on our Pacific coast, near San Diego, last year ears about twice as large were matured in sixty days, indicating that the Copacabana corn may be of use in breeding varieties for short-season conditions in the United States.

that there are none left but me, in this land or out of it, and therefore I now do what I can to relieve my conscience."*

The message carried its own verification. In testifying to the virtues of another race, Serra showed himself possessed of the highest virtues of his own, the love of truth and fairness, and a kindly interest in human welfare, beyond all bigotry of country, creed, or race. Many Spaniards appreciated the Incas, but were powerless to save them. The individual was helpless, for it was a clash of systems, with no basis of common understanding. Writers of large historical works like Garcilasso de la Vega and Cieza de Leon may be suspected of color-

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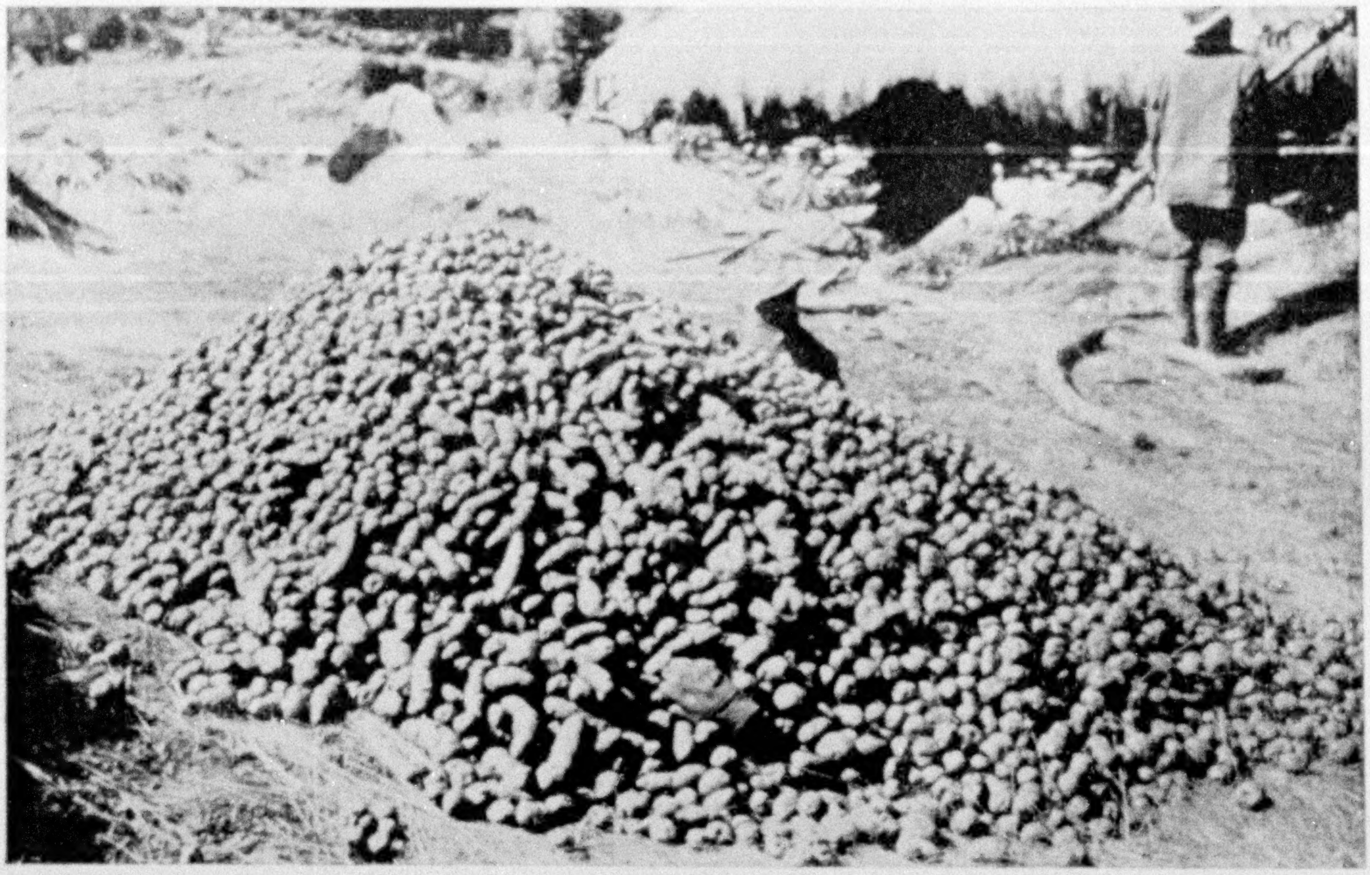
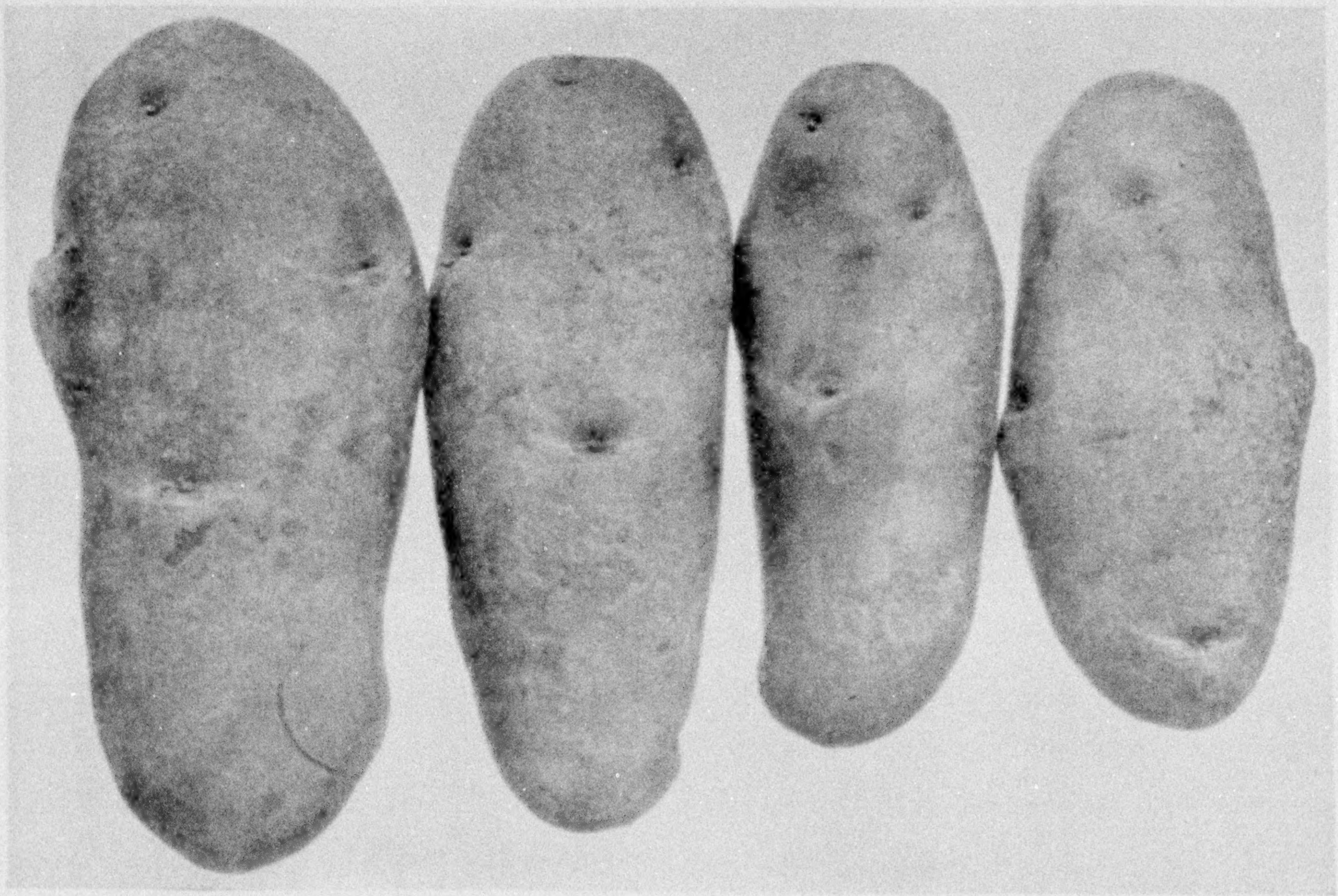
* The Travels of Pedro de Cieza de Leon; translated by Clements R. Markham. Volume 33, Hakluyt Society, pages 32-33, 1864.



SIXTEEN POTATO VARIETIES FROM ONE FIELD

The pile is a mixture of many varieties grown at a high elevation near the Pass of Panticalla. The natives do not grow fields of separate varieties, although they distinguish and have names for many different sorts, which are widely recognized.



Photographs by O. F. Cook

THE POTATO, PERU'S GIFT TO MANKIND, HAS ENRICHED THE WORLD MORE THAN THE IMMENSE HOARDS OF GOLD TAKEN BY THE SPANIARDS

(SEE TEXT, PAGES 510-515)

The popularity of a potato in our market depends largely on whether it is easy to handle and peel. It would be hard to imagine a more convenient potato than this Peruvian variety, called *Pucasuaylla*, of regular, oblong, flattened form, even surface, and few, shallow eyes. It was found by Professor Bingham between Pucyura and Arma, at an altitude of about 12,000 feet (slightly reduced).

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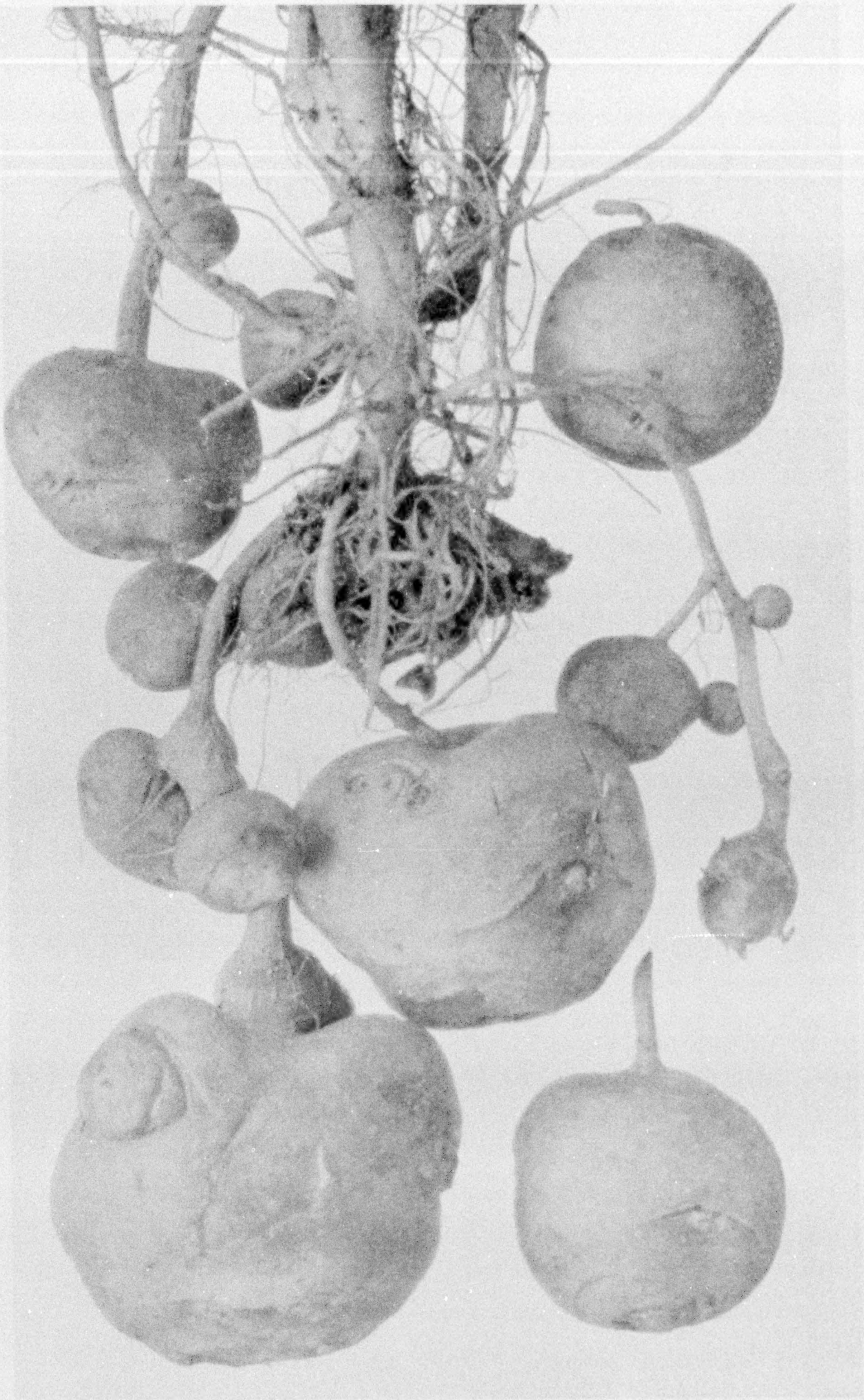
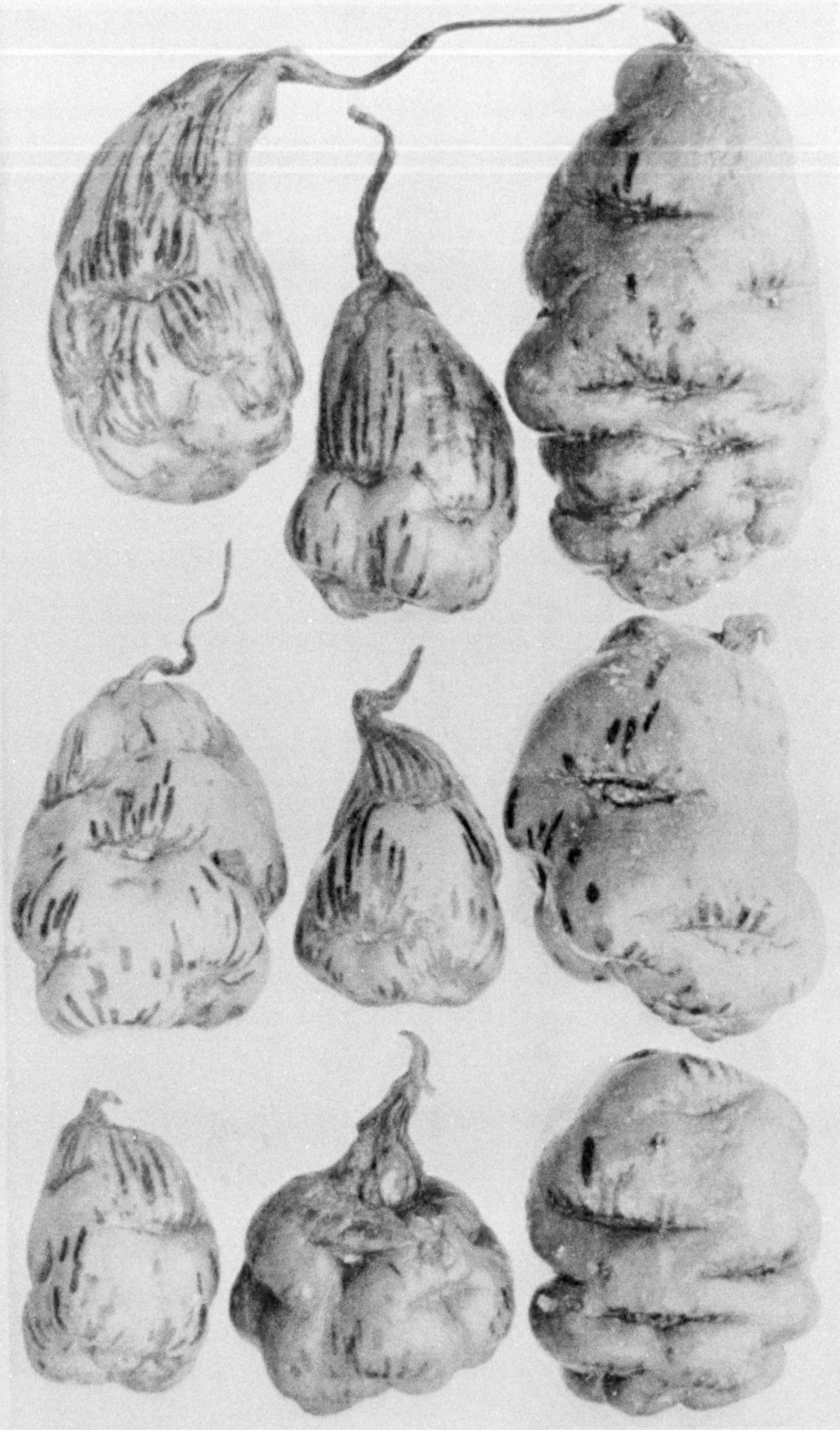


Photograph by O. F. Cook

THE HARDIEST POTATO

A variety of potato grown at the upper limit of cultivation, on the high slopes near the Pass of La Raya, at an elevation of over 14,000 feet. The neighboring vines had their leaves killed by the frost, but this plant was entirely uninjured. Both the rootstocks and the tubers are bluish purple. The variety called *Tutu* is said not to be edible in the fresh state, and to be used only for the making of *chuños* by freezing and drying (natural size).

XUM

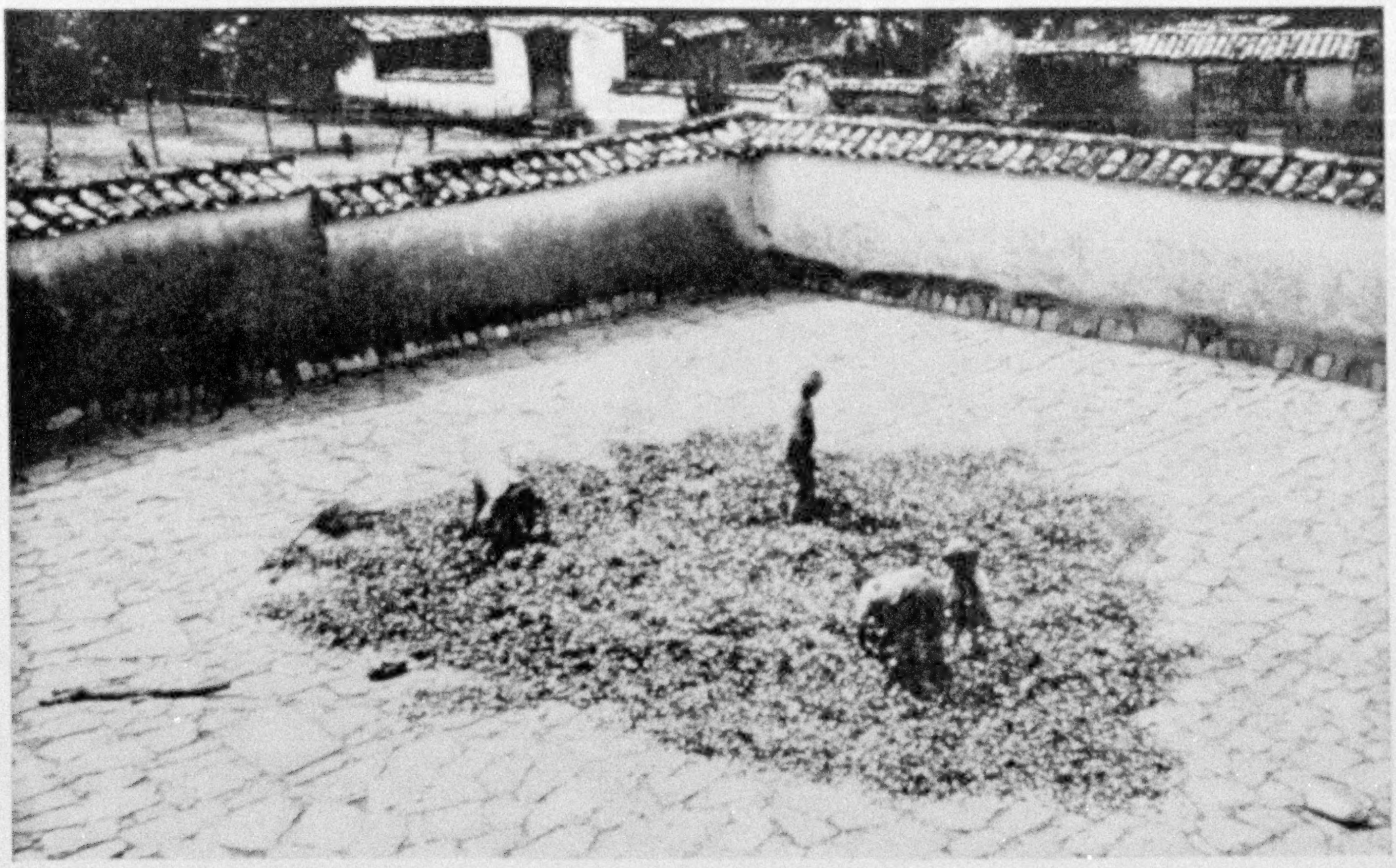


Photograph by O. F. Cook

IN ADDITION TO THE POTATO, PERU HAS ORIGINATED MANY VALUABLE ROOTS (SEE PAGES 513-515)

These are not specimens of hand-decorated Japanese art, but were striped by nature before the tubers were dug. Why the subterranean part of a plant should be decorated with purple stripes is hard to imagine, but the case may be interesting to those who believe that colors must be useful. Two varieties are shown, both called *Checjcheañu*, at Ollantaytambo. The variety at the right, with the larger and more irregular tubers, also has the stripes fewer, shorter, and of a deeper purple color (natural size).

XUM



Photograph by O. F. Cook

COCA-DRYING YARD AT SANTA ANA

The leaves are spread out on the stone pavement and dry rapidly in sunny weather. Rainy weather interferes seriously with the drying operation, for the leaves may have to be spread out and carried in several times. If a sudden rain wets the coca before it can be taken under cover, the leaves are discolored and their commercial value is reduced.

ing their accounts to convey a special impression, but no literary bias can be suspected in Serra. He tells us only a few facts, but in a way that proves his competence to speak. His testimony is not in conflict with the best historians, but more vital and convincing.

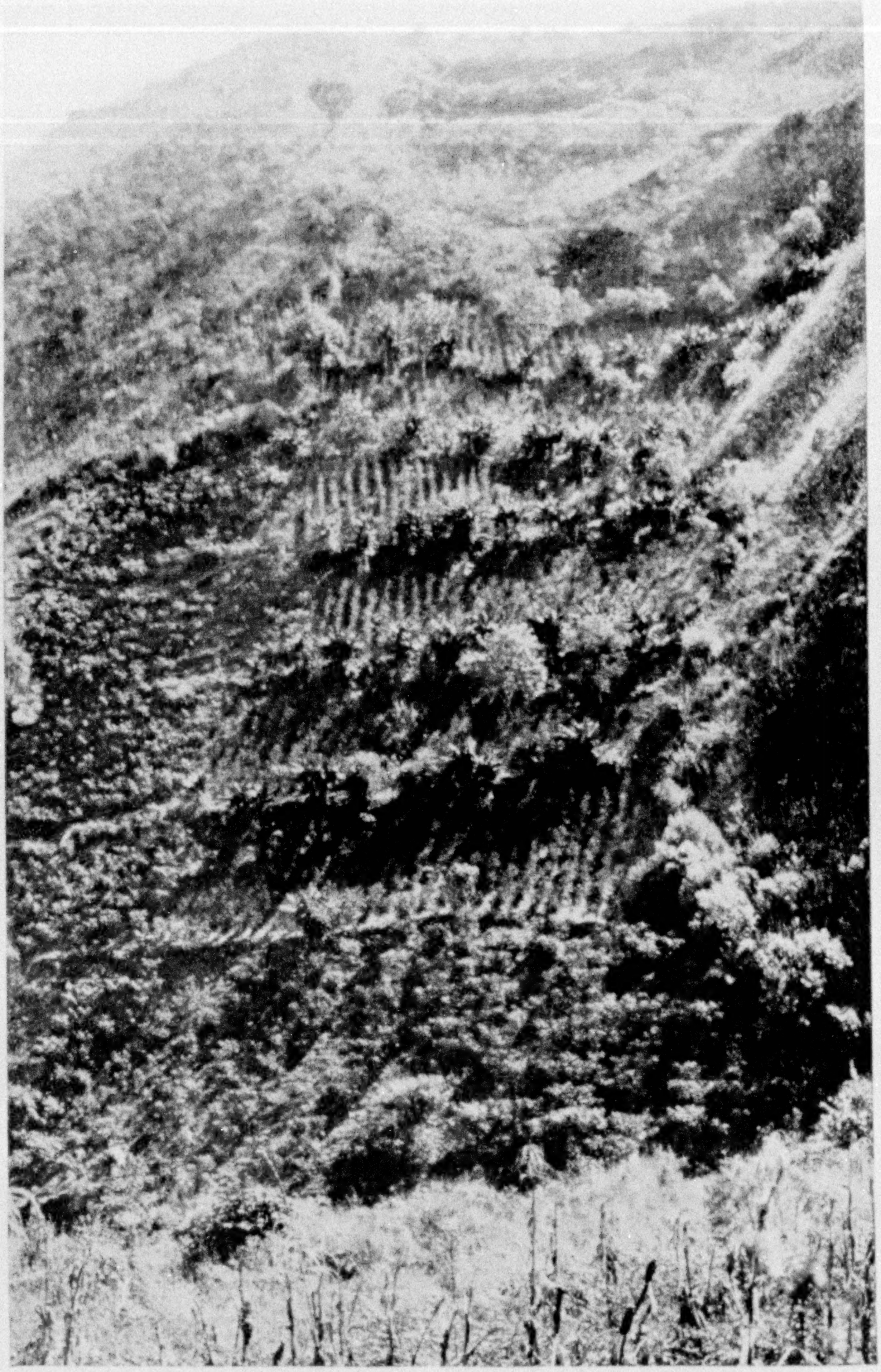
If Serra had charged the destruction of the native civilization to Pizarro or to any of those afterward in authority in Peru, it would be possible to suppose that his view of the Inca organization was colored by revenge or lasting resentment against some of his own people; but of this there is no indication. He includes himself with the others, blames nobody, and suggests no remedies. Telling the truth to the king is all that he undertakes; but in doing that he lifts the curtain of the past and lets us see for one moment through his eyes, not the mountains or the monuments or the crops of Peru, but the living Inca people and their relations to each other, the most essential condition of the development of the ancient civilization.

THE INCAS HAD THE MOST COMPLETE SOCIAL ORGANIZATION OF WHICH WE HAVE RECORD

We see that the Inca agricultural system was not only the most complete form of social organization of which we have any record, but also gave the most adequate adjustment of the human relations that lead to continual conflict and confusion in other forms of society.

This is not saying that the Inca system was the best possible, or that it was calculated to lead to the highest development of humanity, or that we should adopt it; but the system is interesting and worthy of being understood, since social organization undoubtedly was a very important factor in enabling the Incas and their predecessors to accomplish what they did in agriculture and the attendant arts. Certainly no unorganized people could have executed the ancient reclamation projects or established themselves under so wide a range of natural conditions or domesticated such a varied series of crop-plants. In domesticating these plants

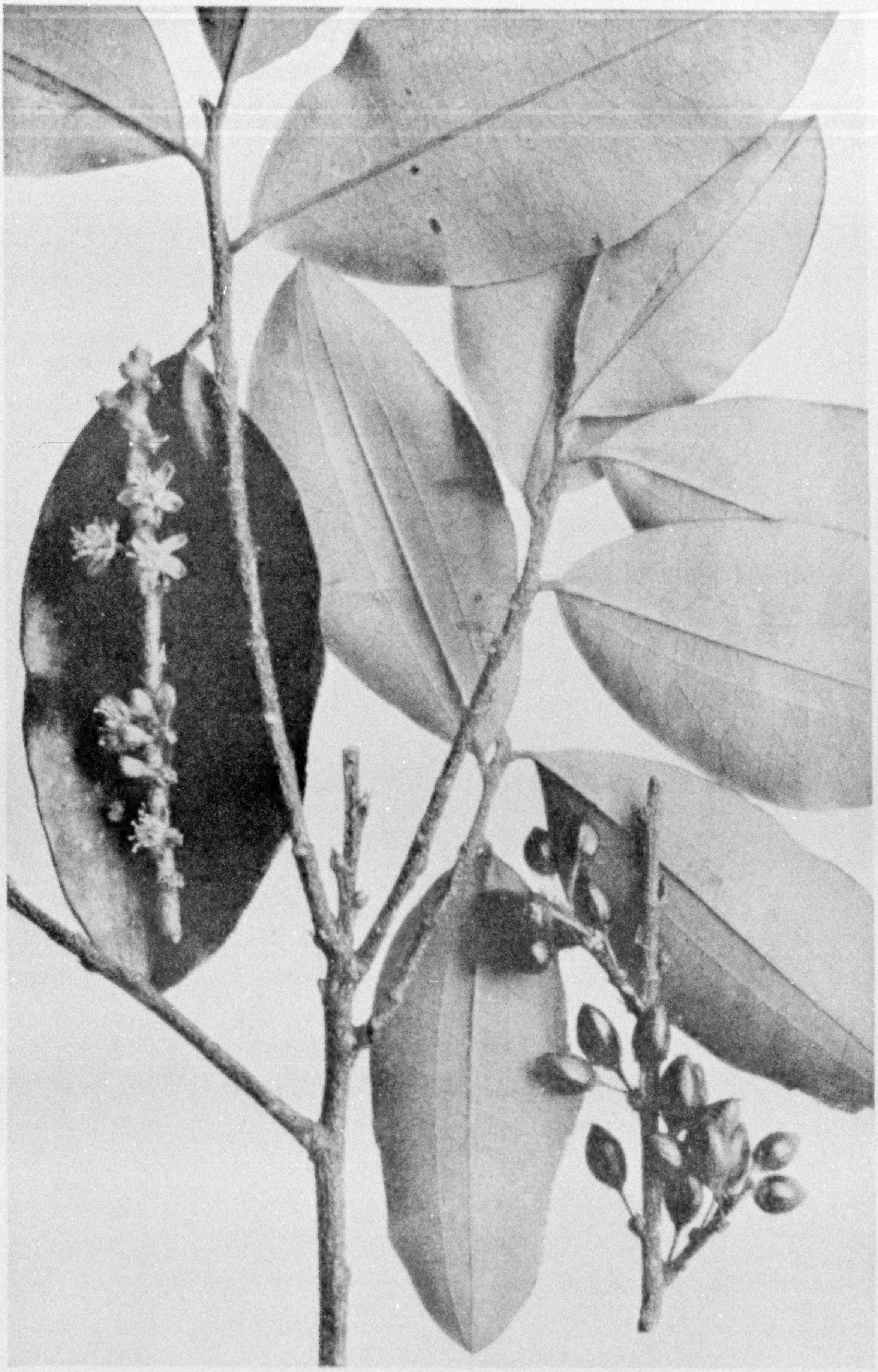
XUM



Photograph by O. F. Cook

WHERE FARMING IS UPHILL WORK

This coca plantation is on a very steep hillside near Colpani, in the lower Urubamba Valley, at an elevation of about 5,000 feet. Many plantations are made in this way on steep slopes. Contrary to the custom that prevails in most tropical countries, the rows always run up and down the slope instead of across.

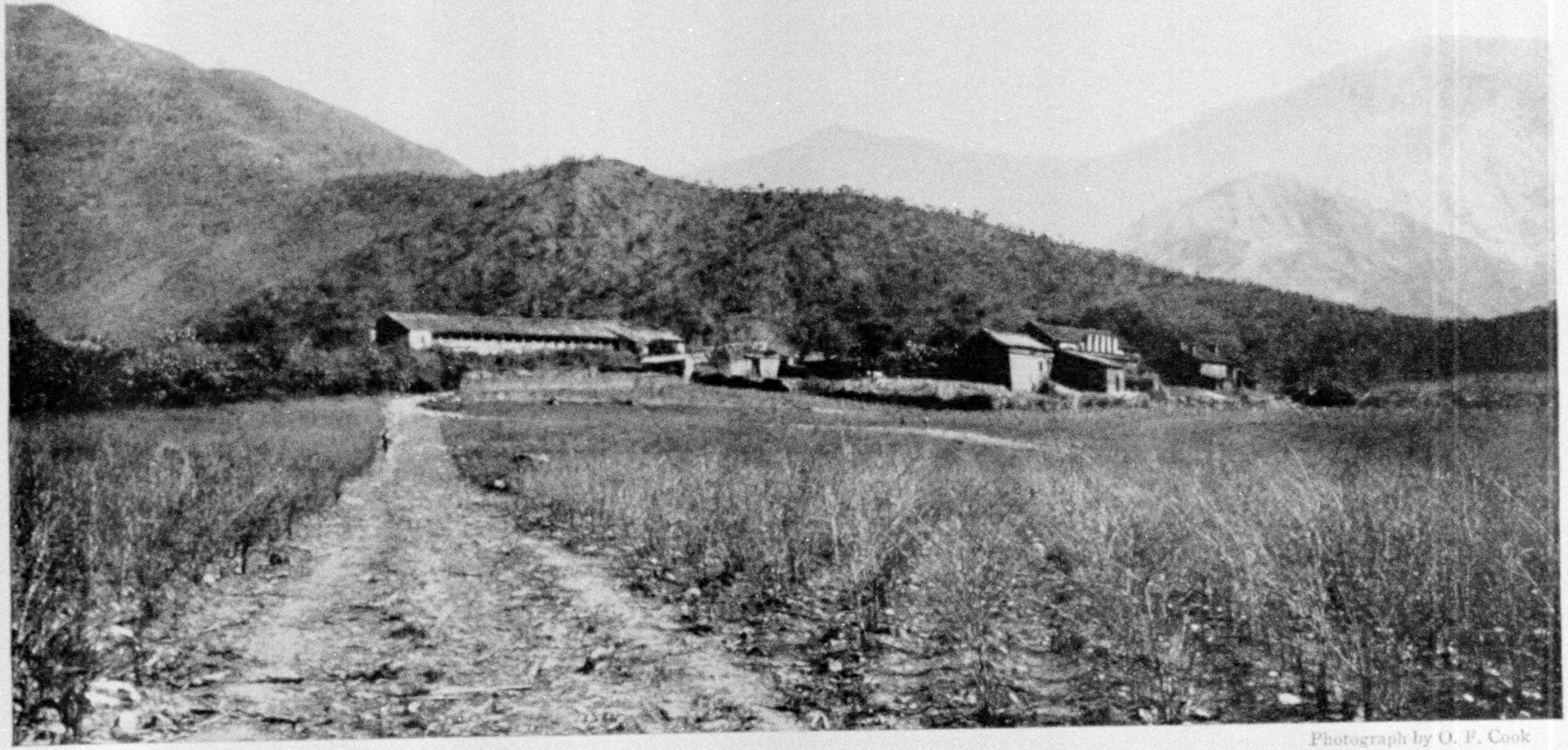


Photograph by O. F. Cook

LEAVES, FLOWERS, AND MATURE BERRIES OF THE COCA PLANT

All the parts are shown in natural size. The leaves, which are the source of the cocaine drug, are very peculiar. The two surfaces are quite unlike—the upper, deep green, smooth, and velvety; the lower, light green, with a band of paler color on each side of the midrib, inclosed by fine ridges. The young leaves are rolled in from the margins, so that only this median band of the lower surface is exposed at first.

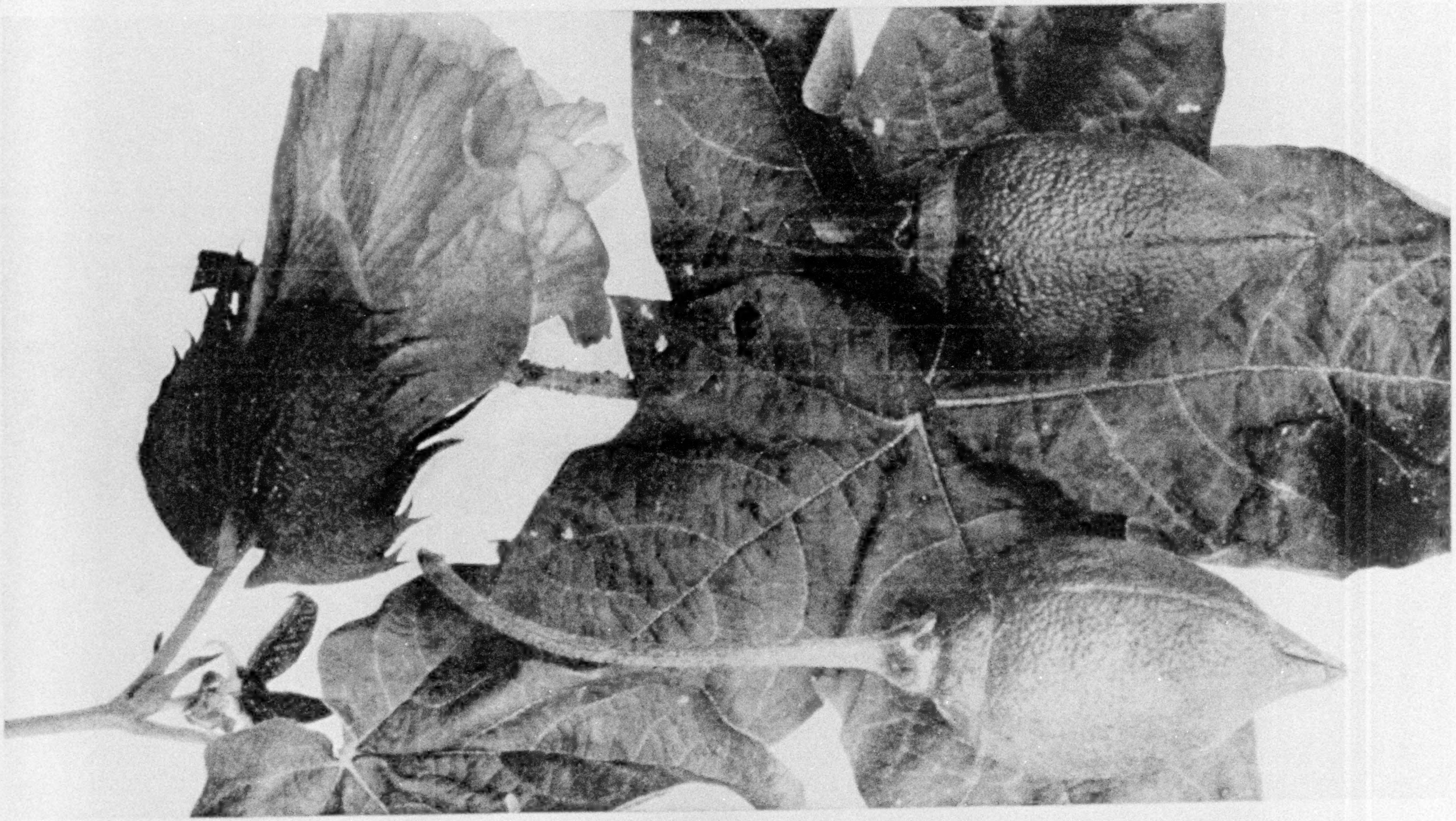
XUM



Photograph by O. F. Cook

A LARGE COCA PLANTATION AT SANTA ANA

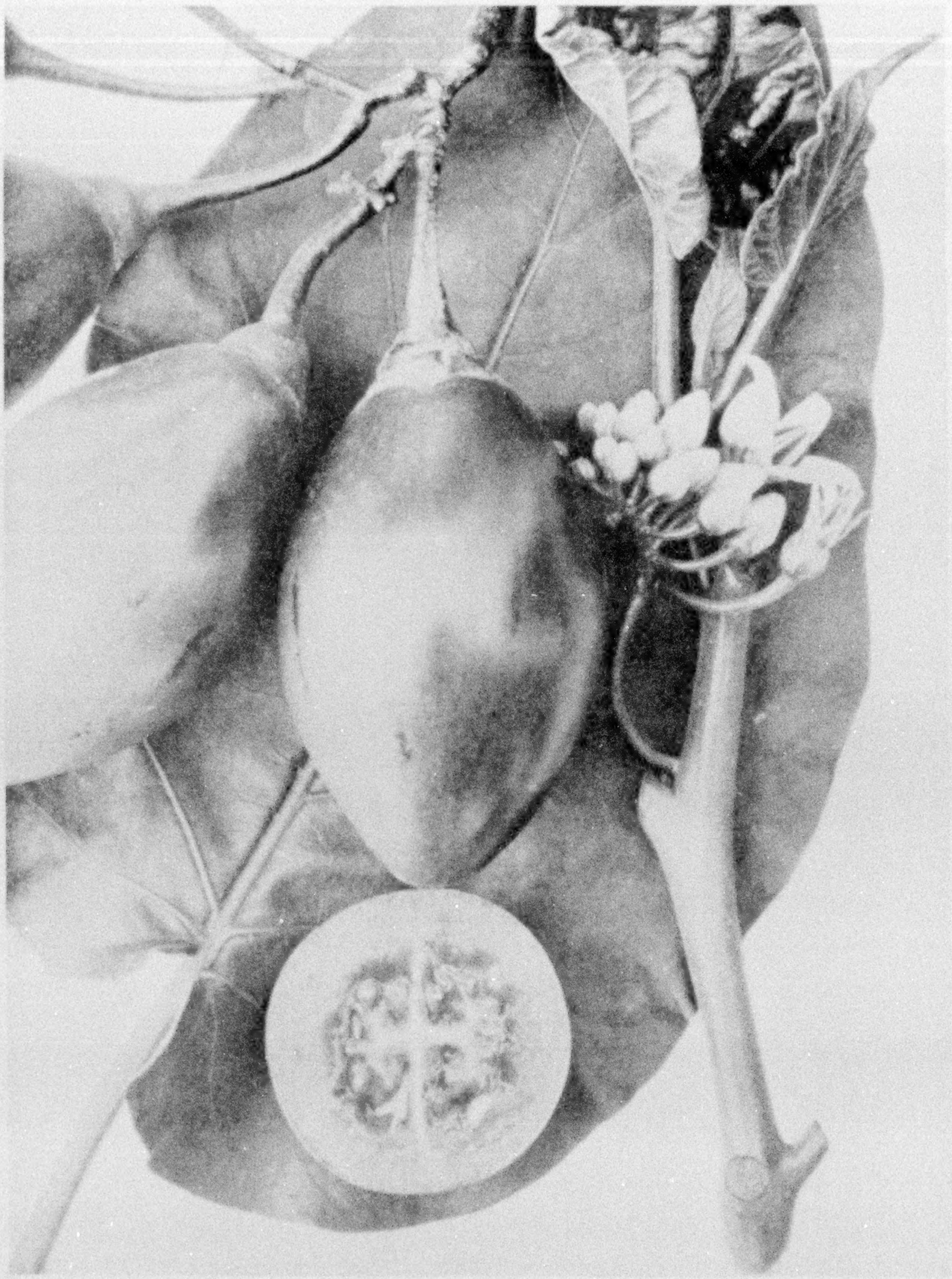
The crop of leaves has just been harvested, leaving the bushes stripped. As soon as the leaves are gathered, the plantation is irrigated and another crop of leaves begins to grow, and matures in about three months. With four crops in a year a good coca plantation is very profitable for the owner and government (see page 473), but a cause of much misery and degradation to the people. Santa Ana is a famous place, having been the chief center of missionary activity in the eastern valleys of the Andes in the early colonial period. The buildings were constructed by the Jesuit fathers.



Photograph by O. F. Cook

A NATIVE PERUVIAN COTTON

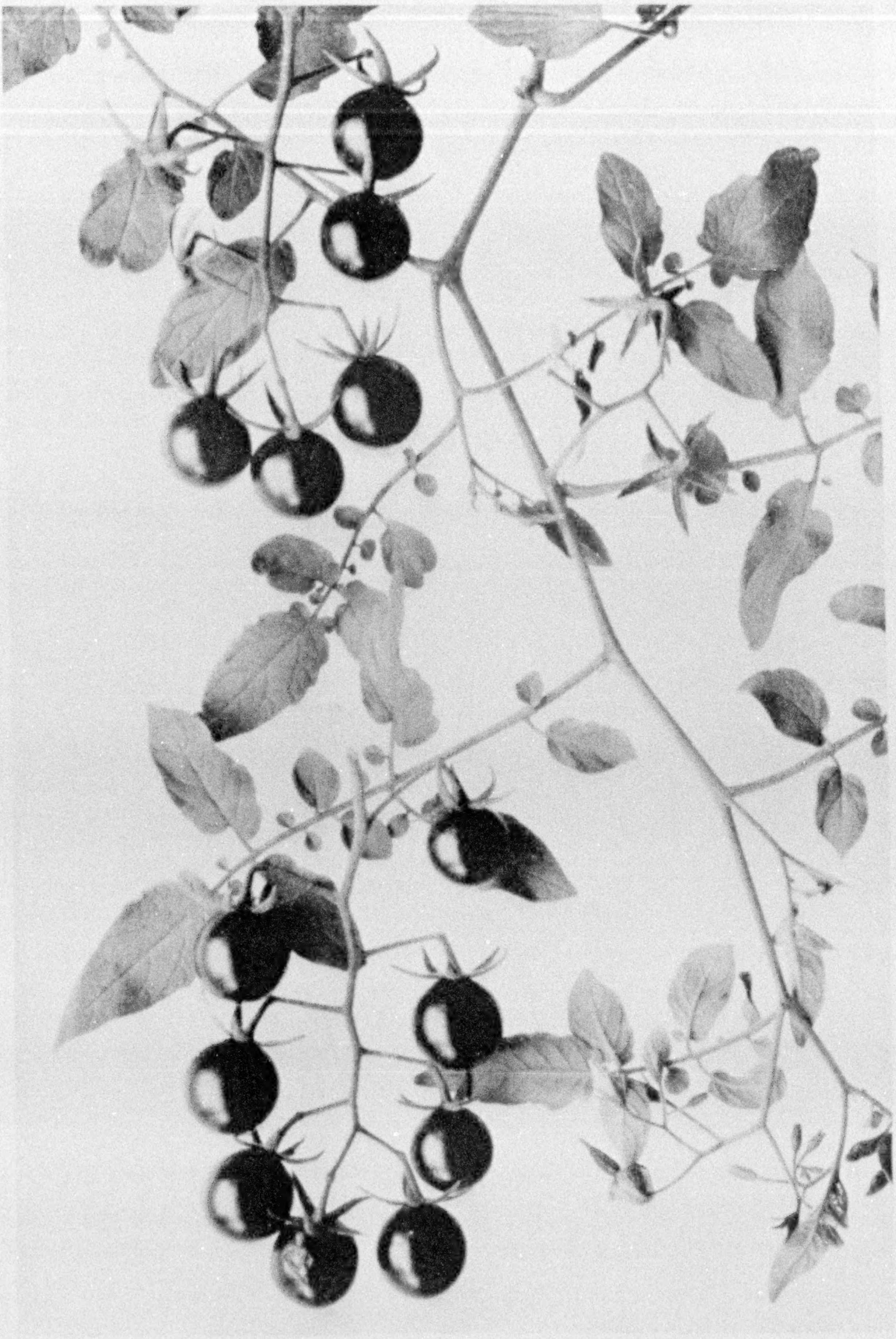
Leaf, flower, and boll of the native cotton grown in the eastern valleys of the Andes. This species (*Gossypium barbadense*) is entirely different from any grown in the United States. The plant is somewhat like the Sea Island cotton, but the bolls are much larger than those of Sea Island and the fiber is more like Upland cotton (natural size).



Photograph by O. F. Cook

THE TREE TOMATO, CYPHOMANDRA

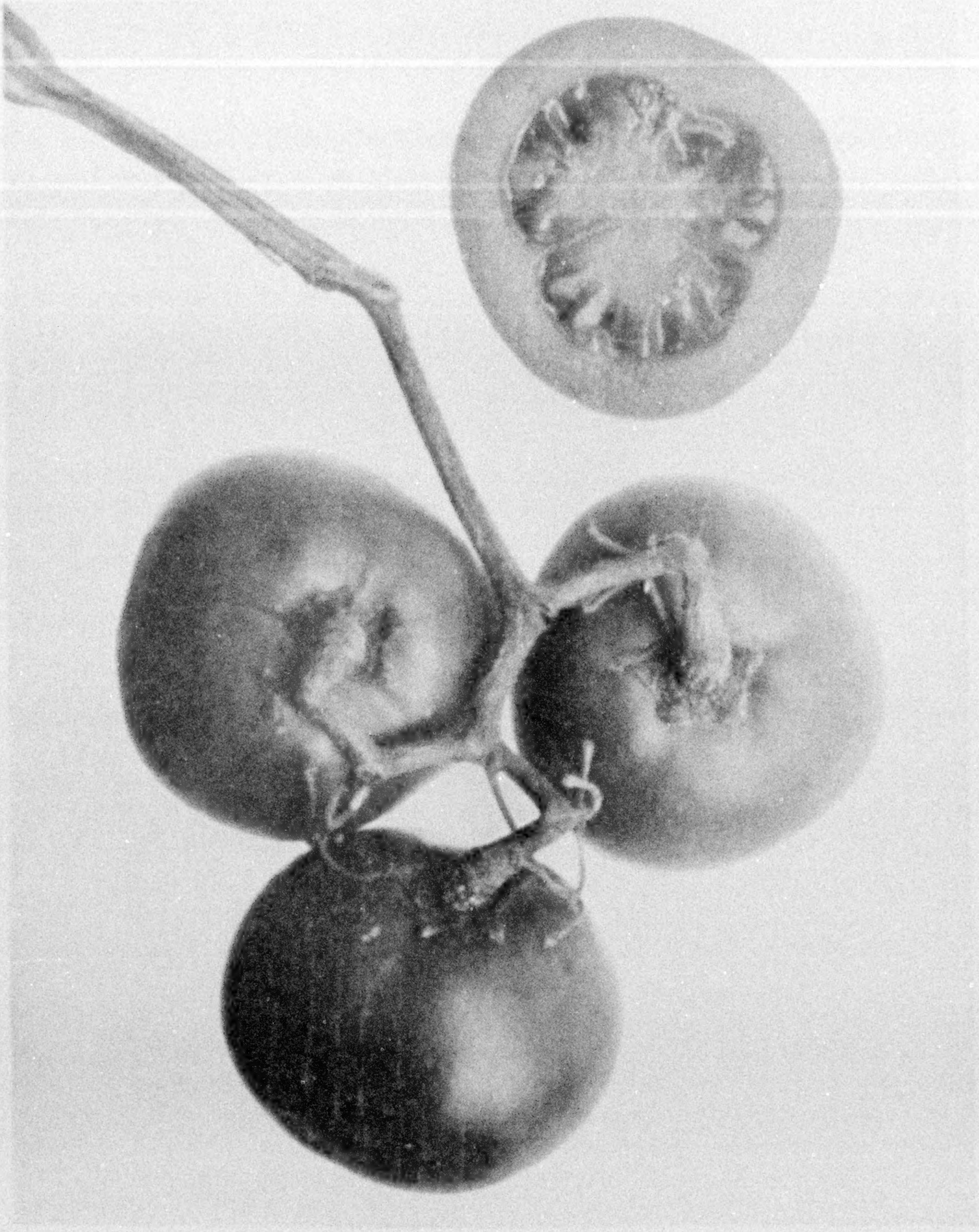
It is a relative of the true tomato, but is more upright, with a single strong stalk and horizontal branches at the top, forming a small tree five or six feet high. The fruits are narrowed at both ends, yellowish red in color, firmer in texture than our tomatoes and with a somewhat stronger taste. The plant endures more cold than the true tomato and is cultivated at elevations of 6,000 to 10,000 feet, whereas the true tomato is raised only in the warm valleys, below 6,000 feet (natural size).



Photograph by O. F. Cook

A WILD-CHERRY TOMATO OF THE URUBAMBA VALLEY

Wild tomatoes of the cherry type are very abundant in the lower Urubamba Valley about Santa Ana at an elevation of approximately 3,000 feet. The color of the fruits is deep red and the taste very agreeable. The tomatoes cultivated by the Indians are of the same type and the fruits not much larger (natural size).



Photograph by O. F. Cook

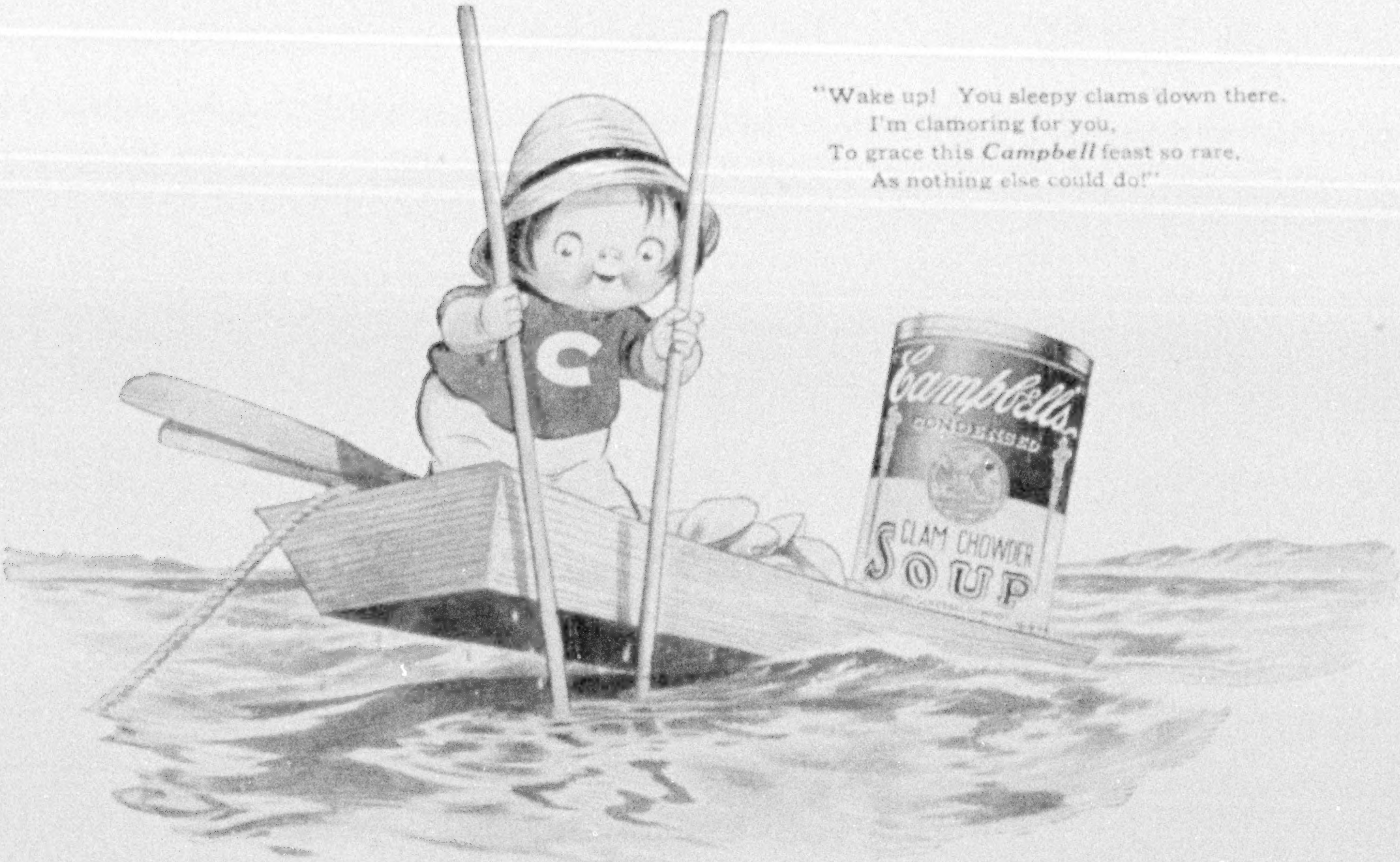
A WILD TOMATO OF THE EASTERN ANDES

Growing as a large woody vine at elevations of 8,000 feet, this plant trails over bushes 10 to 12 feet high. The fruits are of uniform size and of the usual form of our cultivated tomatoes. The flesh under the skin is thick and firm, so that the fruits can be handled easily and kept for long periods. There is a possibility of making use of it in hybridizing and breeding new varieties. If such a cross can be made, it may be expected to give a wide range of variation and yield new types of fruit adapted to special purposes, such as woody perennial varieties that can be trained over arbors like grape-vines, or varieties with special flavors, greater firmness of flesh, and improved keeping qualities (natural size).

the ancient Peruvians performed a lasting service for the whole world. We are all beneficiaries of the ancient Peruvian agriculture.

From our point of view, the steep, narrow, rocky valleys of southern Peru would represent a most unfavorable condition for agricultural development; but no doubt the ancient people saw things in a different light, and what they were able to accomplish is a lesson in possibilities that our own race has still to learn. We are beginning to see that the agricultural ideal of human welfare, of living and letting others live around us, is higher than the military or savage ideal of killing all strangers through fear or jealousy of competition. But our traditions, literature, and social institutions are still so largely military or commercial that we have not seriously considered agriculture as an aim or ideal of existence. We have not sent forth our imaginations to grasp a vision of agricultural development, either for humanity as a whole or for our own European race in the new continent that we have overrun but not yet occupied.

"Wake up! You sleepy clams down there.
I'm clamoring for you,
To grace this *Campbell* feast so rare,
As nothing else could do!"



Fresh from their briny beds.

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Campbell's Clam Chowder

We cut these tender clams into small dainty bits and combine them in their pure natural juice with cubed potatoes, tomatoes and fine herbs for flavoring.

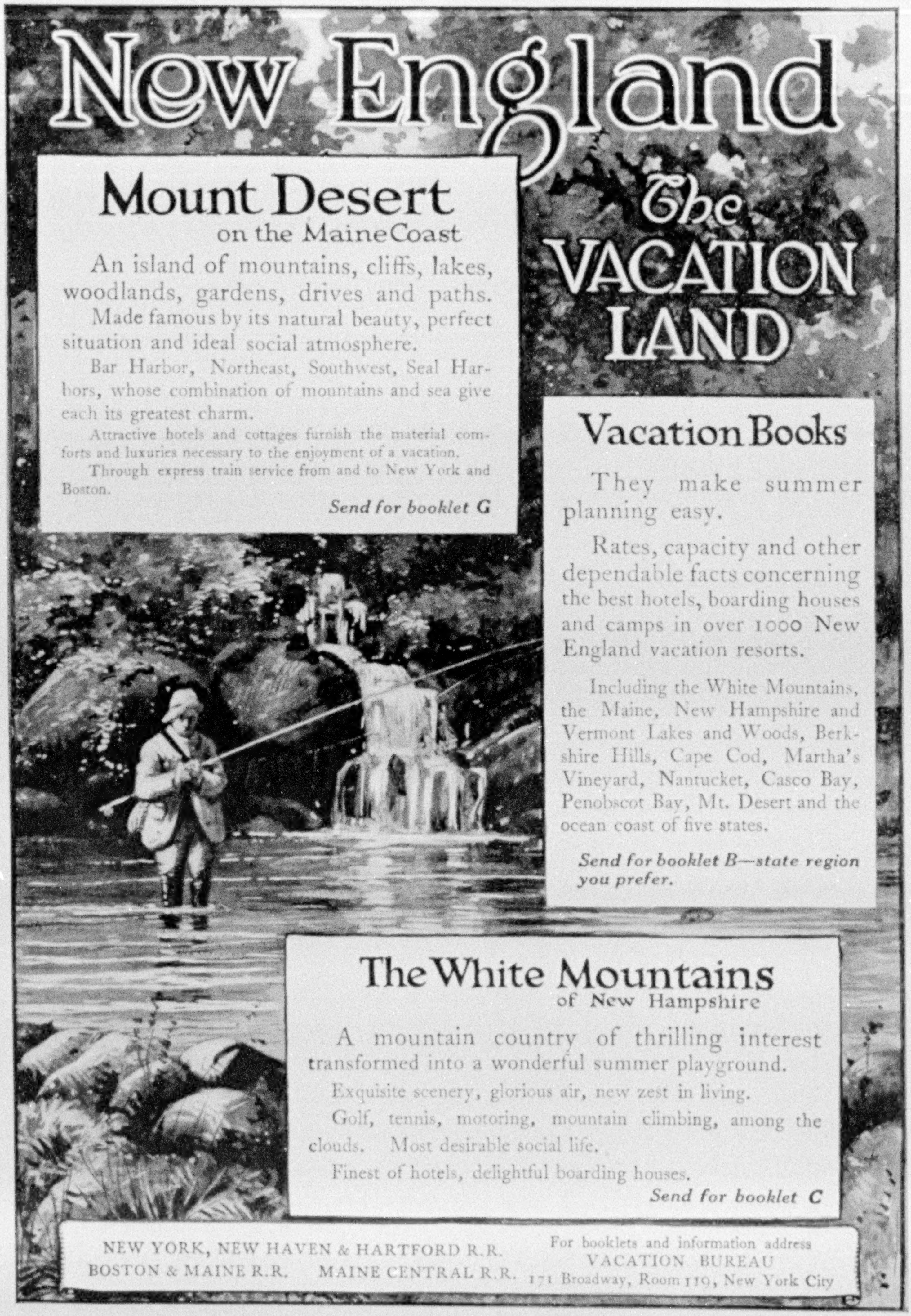
A rich and invigorating chowder with a wholesome tonic quality most satisfying and delightful.

By following the simple directions on the label this perfect chowder is conveniently made ready for your table in three minutes.

21 kinds **10c a can**

Campbell's SOUPS

LOOK FOR THE RED-AND-WHITE LABEL



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Comfort Tires, Protected Against Blow-out

GOODYEAR Cord Tires were chosen as standard equipment for Peerless cars because they offer very definite and very valuable advantages.

Since these advantages result in unusual mileage and service, freedom from tire worry, and great comfort, they are well worth critical attention from owners of fine cars.

It is almost impossible for Goodyear Cord Tires to stone-bruise and blow out, because of their extreme flexibility.

This comes from their construction, which also makes them extremely lively, speedy and responsive.

Strong, pliable cords—placed loosely side by side in diagonal layers—are cushioned in strong, stretchy rubber. Having no binding cross-weave, they are allowed great freedom of movement.

So, under impact, the cords flex, the rubber gives; the tire literally absorbs road obstructions.

This insures against stone-bruise, rupture, and the blow-outs—immediate or subsequent—which follow these injuries.

Naturally such a tire has long life, gives great mileage, and causes little delay and annoyance.

And it permits high speeds with comfort. It has wonderful coasting qualities. It saves power. It increases gasoline mileage.

In the Hudson Hill coasting test, Goodyear Cord Tires averaged 177 feet farther than ordinary cord tires on the same car; and reached a maximum speed of 36 miles per hour.

Of the fifteen Franklin cars which recorded better than 40 miles per gallon of gasoline in the fuel economy test last May, ten were equipped with Goodyear Cord Tires. And these tires made the three highest marks—55 miles, 53 miles, and 51.8 miles per gallon of gasoline.

Their great oversize, uniting the added cushion of an increased air-volume with the in-built cushion, resilience, and easy-running of our cord construction, makes the Goodyear Cord the tire of utmost comfort.

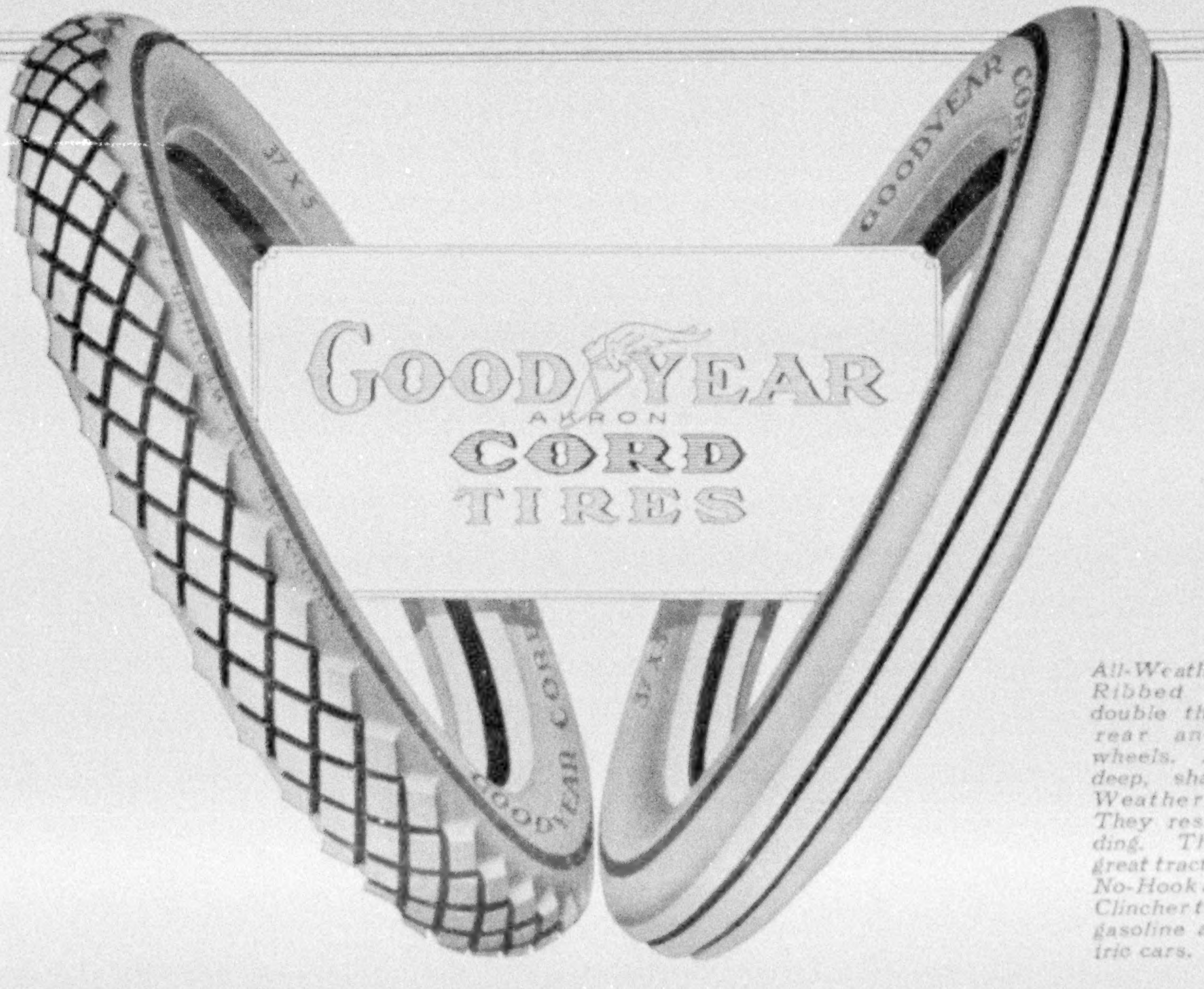
Goodyear No-Hook Cord Tires, in the 32 x 4, 36 x 4½ and 37 x 5-inch sizes, have 23 to 35 per cent more air space than regulation Q. D. Clincher tires of corresponding inch-sizes.

In spite of the higher prices necessary for these tires, because of their construction and their oversize, users seldom change to other tires.

Increasing sales show that car owners believe the extra value, and the extra luxury, security and durability of these tires, more than offset the difference in price.

Ask the nearest Goodyear Service Station Dealer for Goodyear Cord Tires.

The Goodyear Tire & Rubber Company
Akron, Ohio



All-Weather and Ribbed Treads, double thick, for rear and front wheels. Note the deep, sharp All-Weather grips. They resist skidding. They give great traction. No-Hook and Q. D. Clincher types, for gasoline and electric cars.

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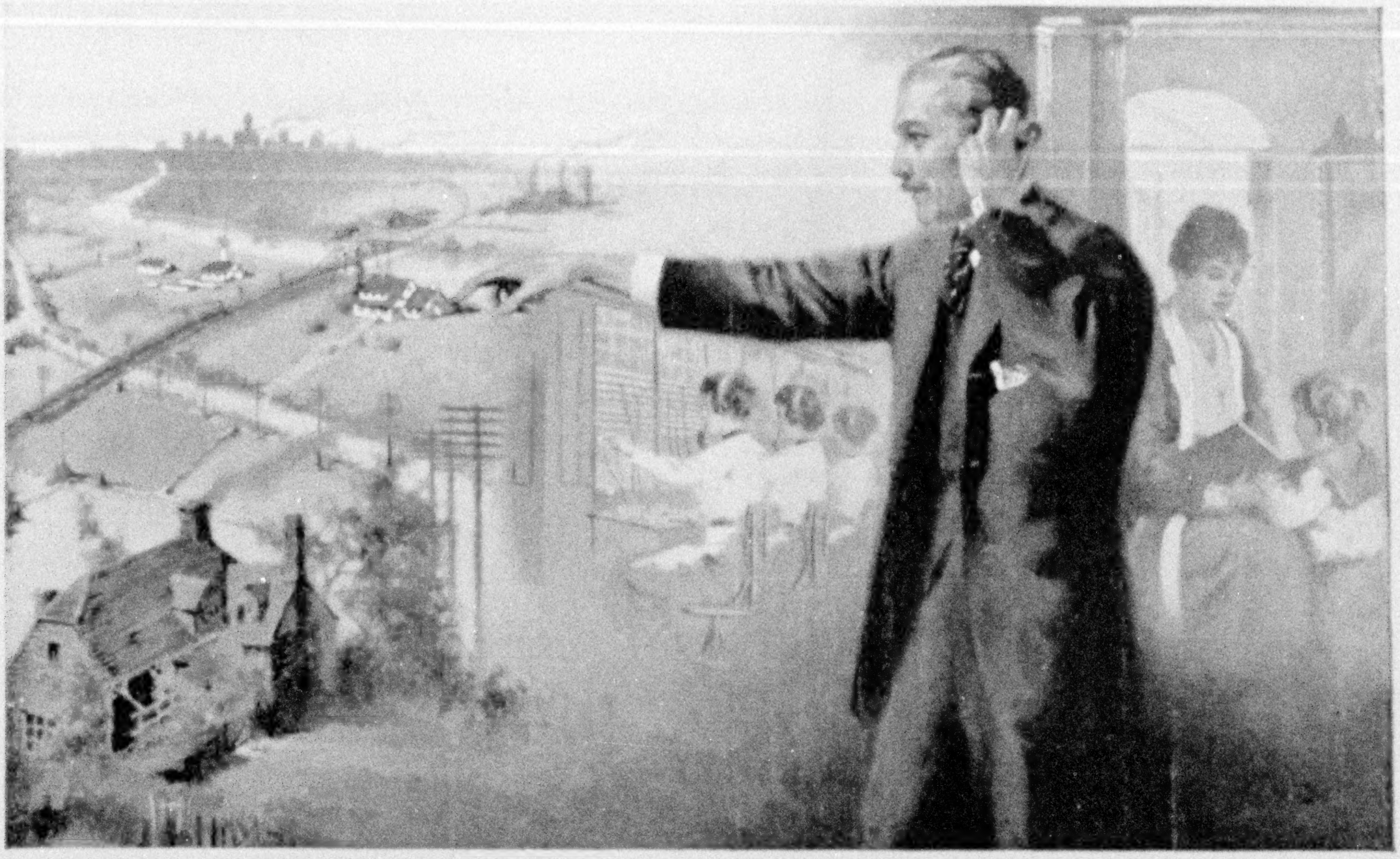

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In the development of the telephone system, the subscriber is the dominant factor. His ever-growing requirements inspire invention, lead to endless scientific research, and make necessary vast improvements and extensions.

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In the Bell System you have the most complete mechanism in the world for communication. It is animated by the broadest spirit of service, and you dominate and control it in the double capacity of the caller and the called. The telephone cannot think and talk for you, but it carries your thought where you will. It is yours to use.

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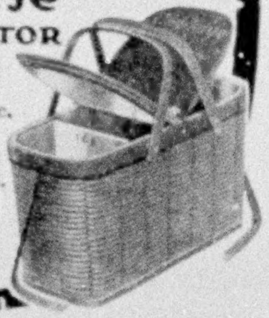

The Big Tree Panorama

ADDITIONAL copies of the beautiful picture of the giant tree, "The Oldest Living Thing," included as a photogravure panorama in the April, 1916, issue, can be obtained, unfolded, on artist proof paper, ready for framing, postpaid in the United States, at 50 cents each.

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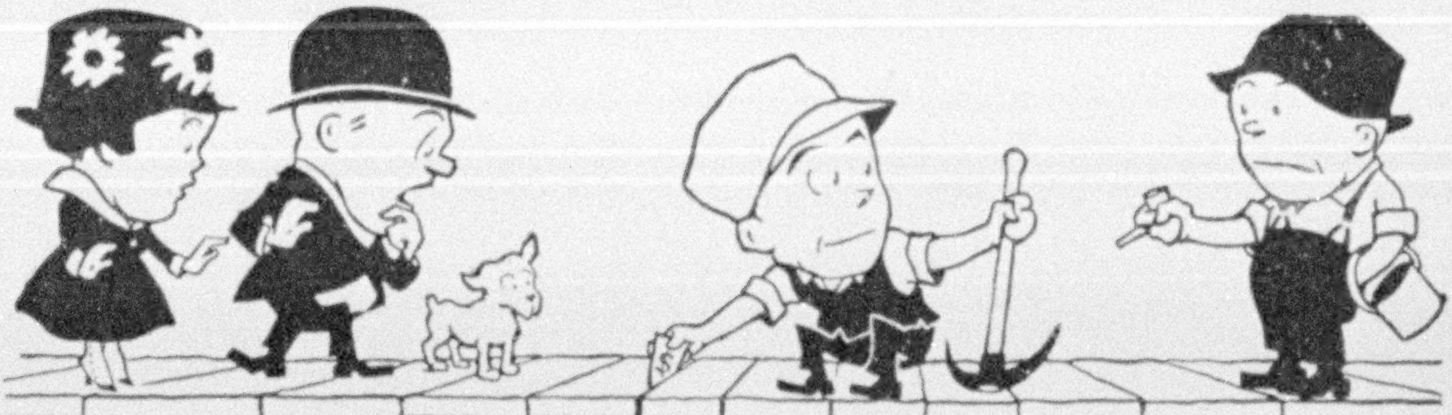

"Whativer ar' ye doin', Pat, sticking that dollar bill doon that crack?"

"Why, I dropt a dime, an' I'm making it worth me while to pull up the plank." Buying another tire of the same make to save the allowance due on an undelivered guarantee is a very similar performance.

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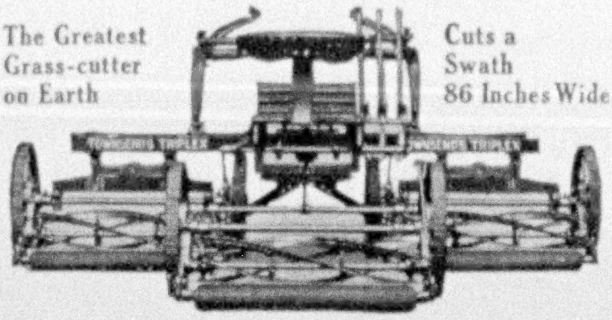

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86 Inches Wide

Floats Over the Uneven Ground as a Ship Rides the Waves.

One mower may be climbing a knoll, the second skimming a level, while the third pares a hollow.

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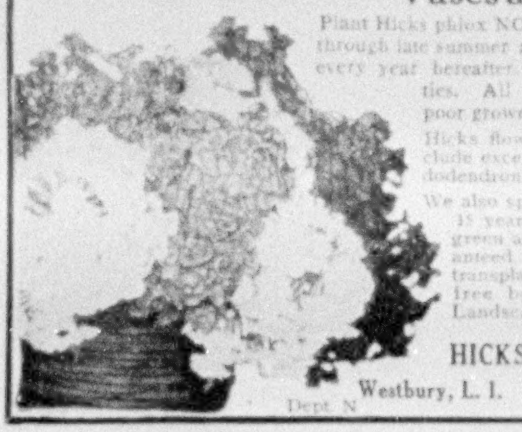

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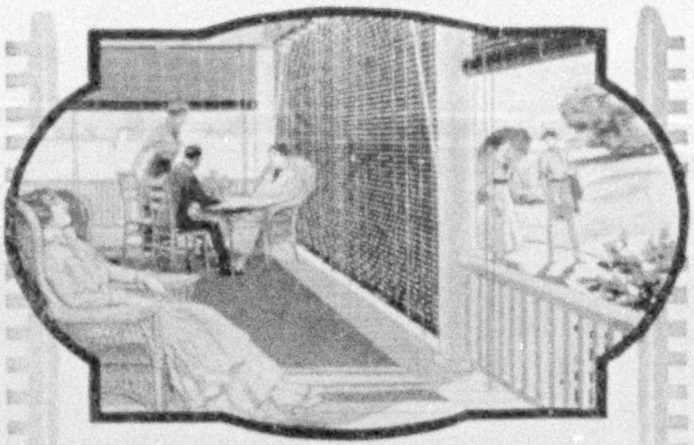

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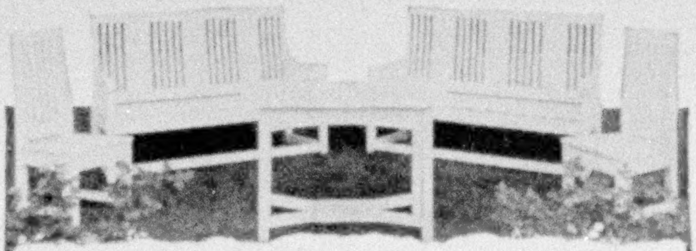

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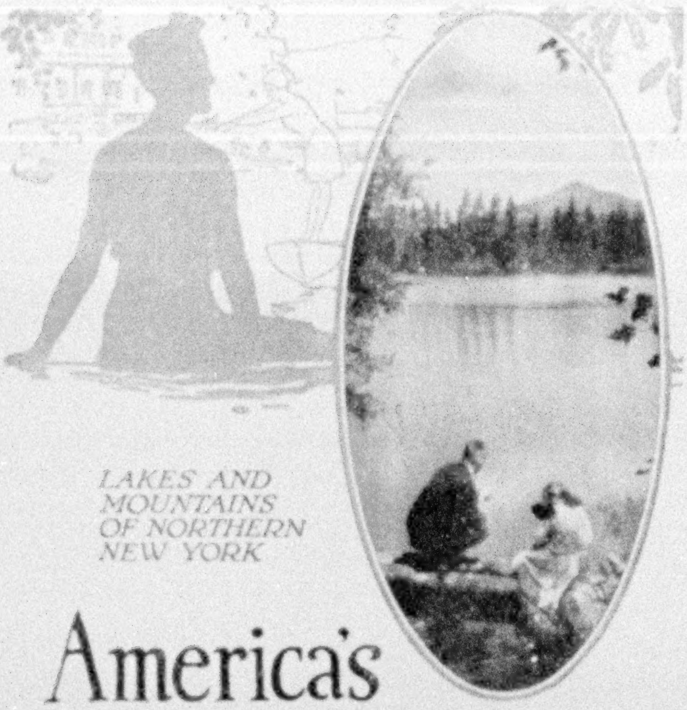

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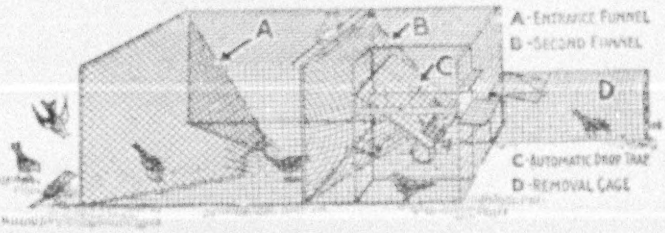

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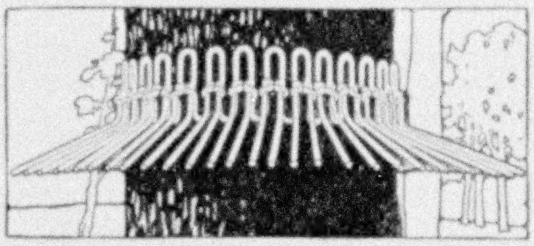
does the work automatically and humanely.

$6.00 F. O. B. Kankakee, Ill. Sparrows fight and drive out song birds. They are noisy, quarrelsome, and destructive. This trap catches them by the hundreds as soon as set. Rid your yard of these pests. No other trap like it.



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Expands with tree. Simple and easy to attach. About three feet required for average tree. Both of these devices are made by a man who has spent over twenty years in the study of birds. Dodson's Bird Houses are in every State in the Union. Price, $1.50 to $65.00, in twenty styles. Guaranteed to attract song birds. Send for free booklet describing these ingenious devices.

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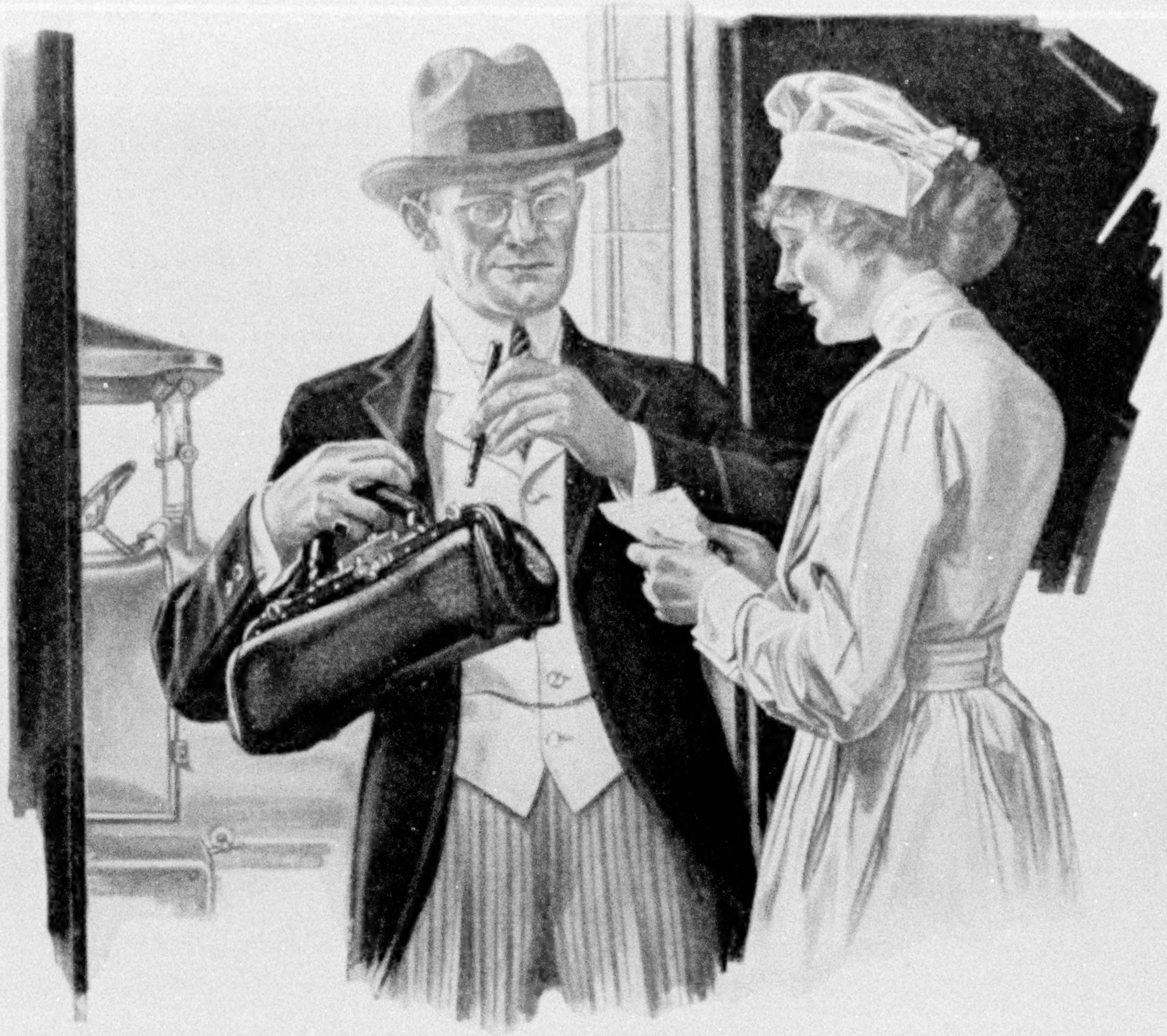
The FRANKLIN CAR



IN the remarkable list of successful men who own and drive Franklin Cars there is an astonishing number of prominent physicians and surgeons.

The busy doctor uses his car all the time.

He is subject to emergency calls—needs to be *sure of his car*.

A car that he can leave at the curb in cold weather *without freezing*, or drive hard on the hottest day *without boiling*.

He must have a car easy to get into and out of. One that he can ride in all day *without fatigue*.

The typical Franklin owner, whether he is a doctor or not, is a man who buys his car to *use*.

If the average motorist drove his car a *thousand miles or more a month*, he would get a light on service, upkeep and depreciation that would give him some *real standards* for judging motor car *values*.

Every practical-minded motorist should read the new book, "Why the Average Motorist's Dollar is Shrinking." Send us your name on a postcard for a copy.

FRANKLIN AUTOMOBILE COMPANY, Syracuse, N. Y.

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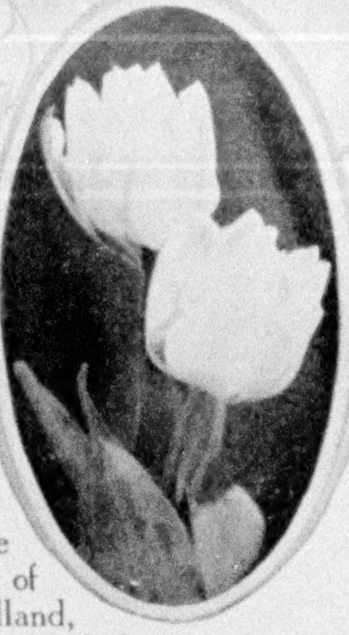

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Hyacinths, Tulips, Narcissi, Crocus, give, for small outlay of time and money, an abundance of flowers in the house from December until Easter, and in the garden from earliest spring until the middle of May. Bulbs are grown almost exclusively in Holland, in enormous quantities, and sold at very low prices. Usually they cost double before reaching you.

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Our orders are selected and packed in Holland, and are shipped to our customers immediately upon their arrival, in the best possible condition.

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	Per 100	Per 500		Per 100	Per 500		Per 100	Per 500
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8-16

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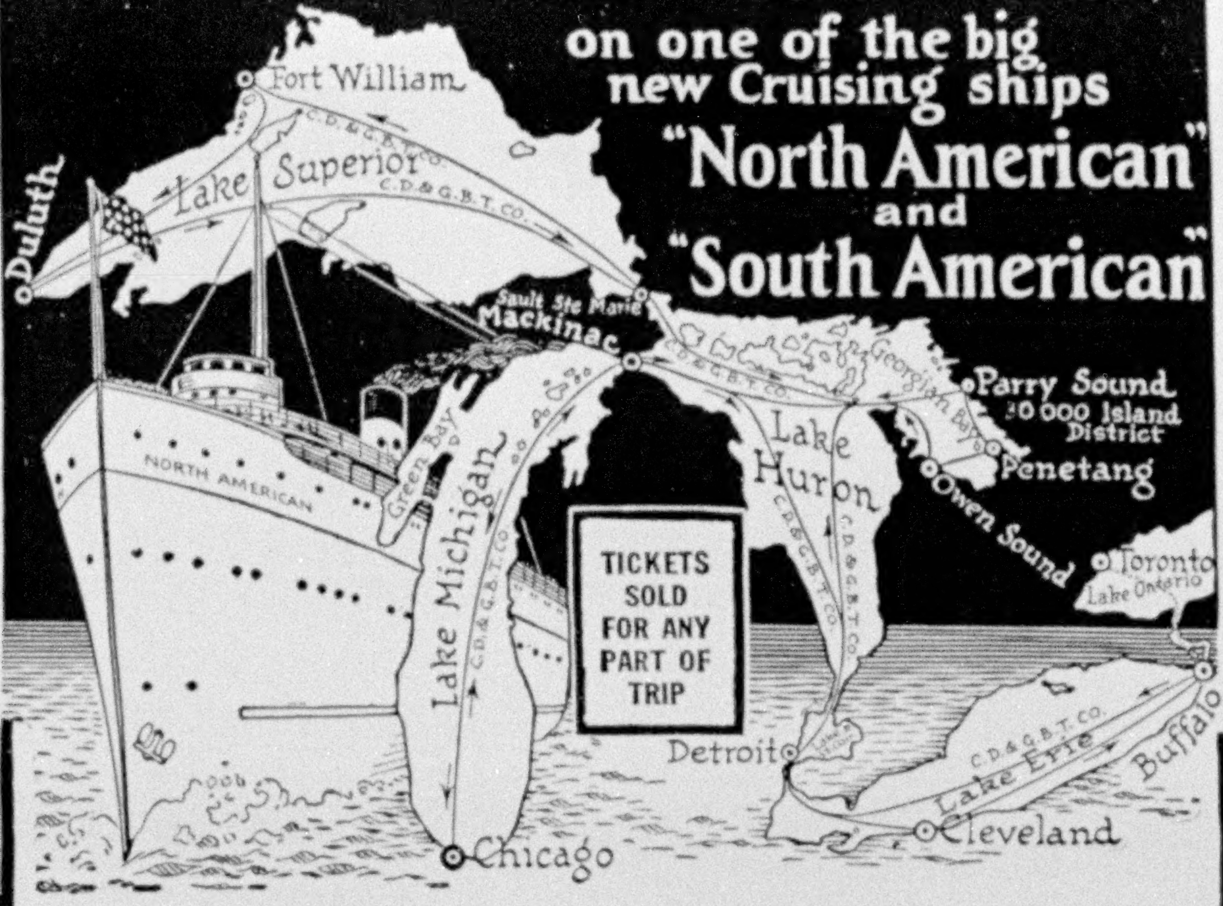

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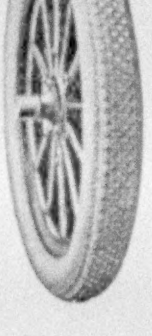

For over three years European motorists have been getting from 10,000 to 15,000 miles out of their tires by "half-soling" them with Steel Studded Treads

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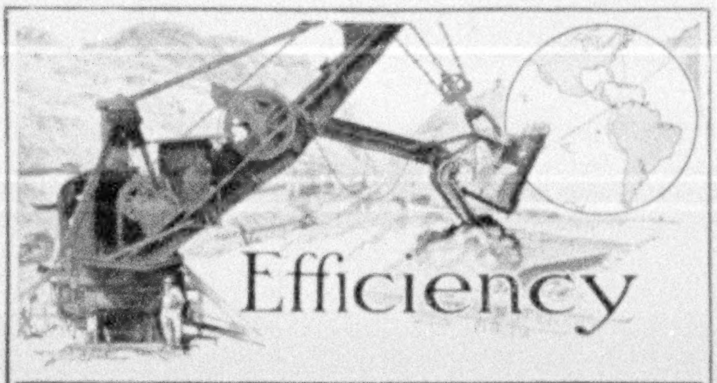

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The General's efficiency comes from having enormous mills, perfectly equipped and favorably located for efficient manufacturing and distribution. Enormous volume and vast stores of raw materials, purchased to the best advantage, make possible the lower cost due to continuous operation.

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Certain-teed is sold by responsible dealers all over the world, at reasonable prices.

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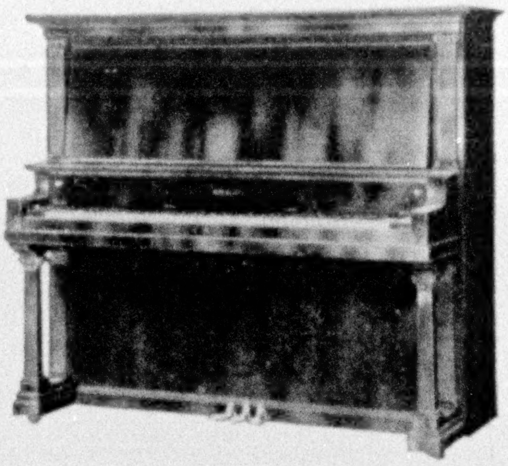

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Another reason is that this **"1916" Acousticon** is not only protected beyond competition by U. S. Patents, but has so many improvements and refinements, all making for greater efficiency, that many of our old customers who have tried it say that its effectiveness far exceeds even that of their old instrument which made them hear so well.

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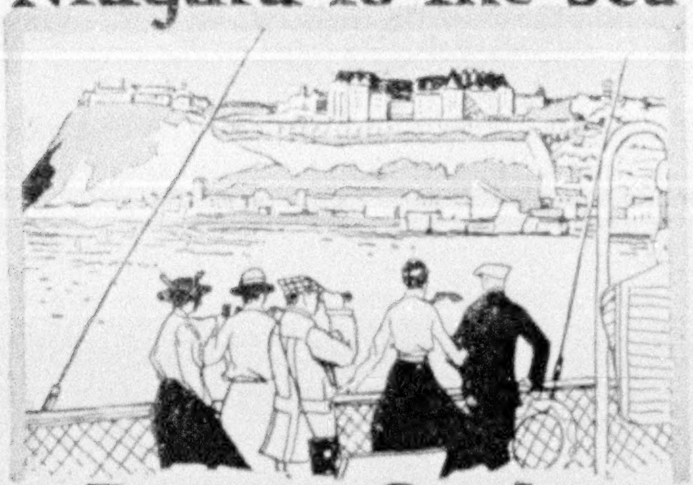

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YOU can make your porch the favorite gathering place for all the family—a shady, secluded refuge from the summer sun, an ideal sleeping room on summer nights, by equipping it with

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Made of Aerolux Splint Fabric, they shut out sun yet let in light and air. **Aerolux No-Whip Attachment**, an exclusive feature, prevents whipping in the wind. Furnished in different grades and colors at moderate prices. An architectural adornment to any home.

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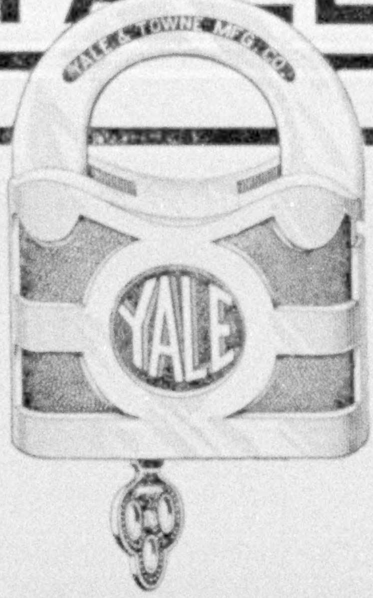

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The Greatest Discourager
Any Intruder Ever Met

There are a hundred and one uses for Yale Padlocks and there are that many sizes and kinds of Yale Padlocks from which to choose—from the little ¾-inch size for a dog collar to the 3½-inch size for a warehouse.

To be sure you get a Yale Padlock, look for the name Yale on it. All Yale products bear the name Yale: House hardware, night latches, padlocks, door closers, cabinet locks, and Triplex Hoists.

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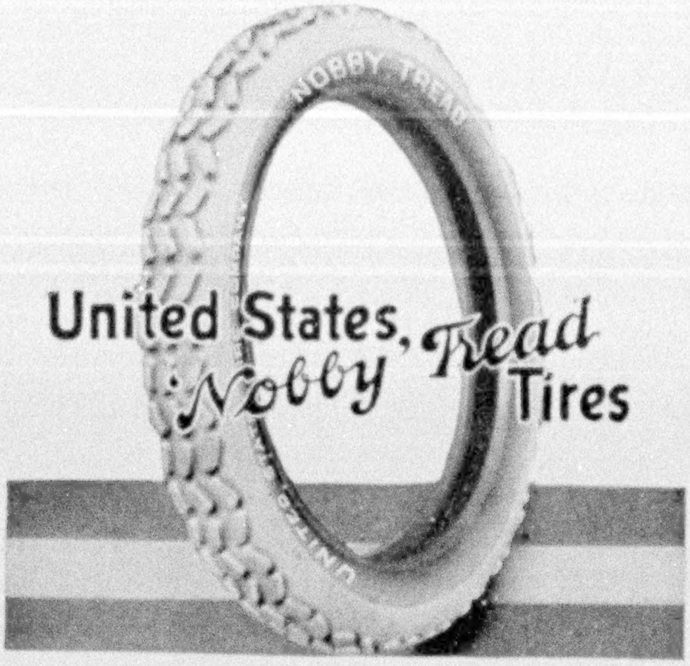
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Knobs—Not Mere Ridges

The knobs stick out from 'Nobby' Tread Tires far enough to protect the tread from nails, sharp stones, and glass.

The knobs are big enough and are so scientifically placed that they add still more resiliency to an already marvelously resilient tire.

The knobs on these "Aristocrats of the Road" hold the ground with a tenacity that says "I will" with every revolution of the wheel.

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Trust *Your* Taste Not Mine

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You have wondered at times if there was a better cigar than your regular smoke at the same or less money. If you are smoking a 10c straight or two for a quarter, there is. But don't take my word for it. Your taste should decide.

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Cigar value is based on one thing only—the fineness of the leaf. There can be no inflated values in J. R. W. cigars, because the salesmen's salaries and expenses and the store up-keep have been eliminated. These savings are made in your favor.

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The leaf I use is selected for me from the crop grown in the Vuelta district of Cuba. Only the best of the year's output is used. Proper aging and careful cigar-making combine to make the J. R. W. a delightful smoke.

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Send me only your name and address on your business card or letterhead, and enclose 10c to cover revenue, postage, and packing. I want you to smoke five from the box I will send you. When you find they are really "your smoke," send me a check or money order and I will replace the five smoked. My price is close to cost—$2.60 for 50, $5.00 per hundred. Write today.

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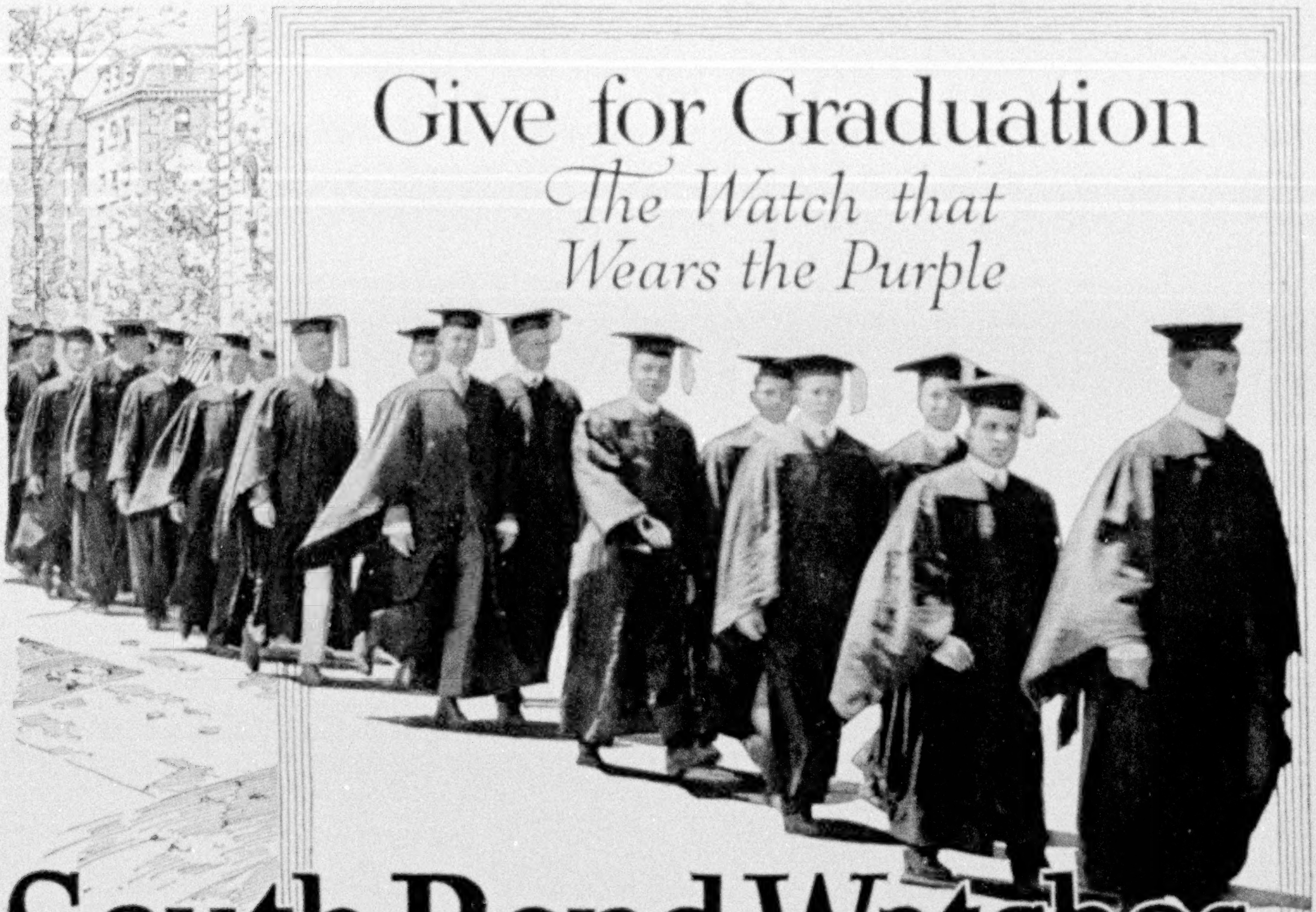

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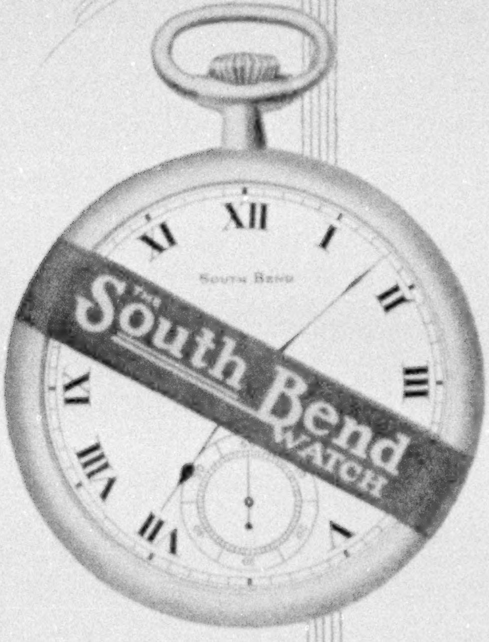

The "Chesterfield"
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By WILLIAM H. TAFT, Former President of the United States
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35 Pages of Color Illustrations
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Washington—The City of Magnificent Distances, destined to be the most beautiful capital in the world—is a source of pride to every American, for Washington belongs to each and every citizen of the Republic.

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The book contains a most wonderful series of illustrations in color, 35 full page plates in four colors, 2 large panoramas, and 1 map, also in color, made from the remarkable plans, drawings, and renderings of the Fine Arts Commission, now on exhibition at the Panama-Pacific Exposition. These pictures are pronounced the most beautiful collection of views of a city ever made, and there are 59 pages of half-tone plates of Washington scenes, in addition—a total of 94 illustrations.

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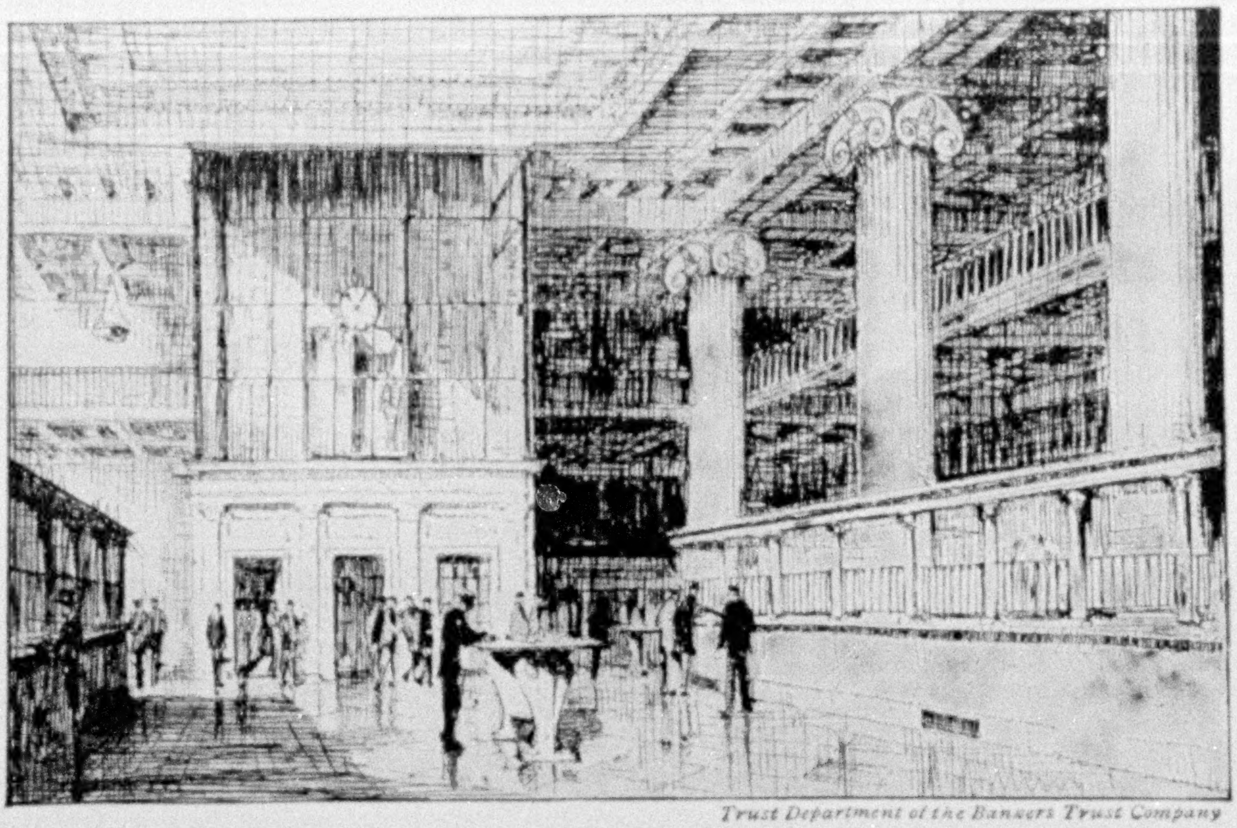

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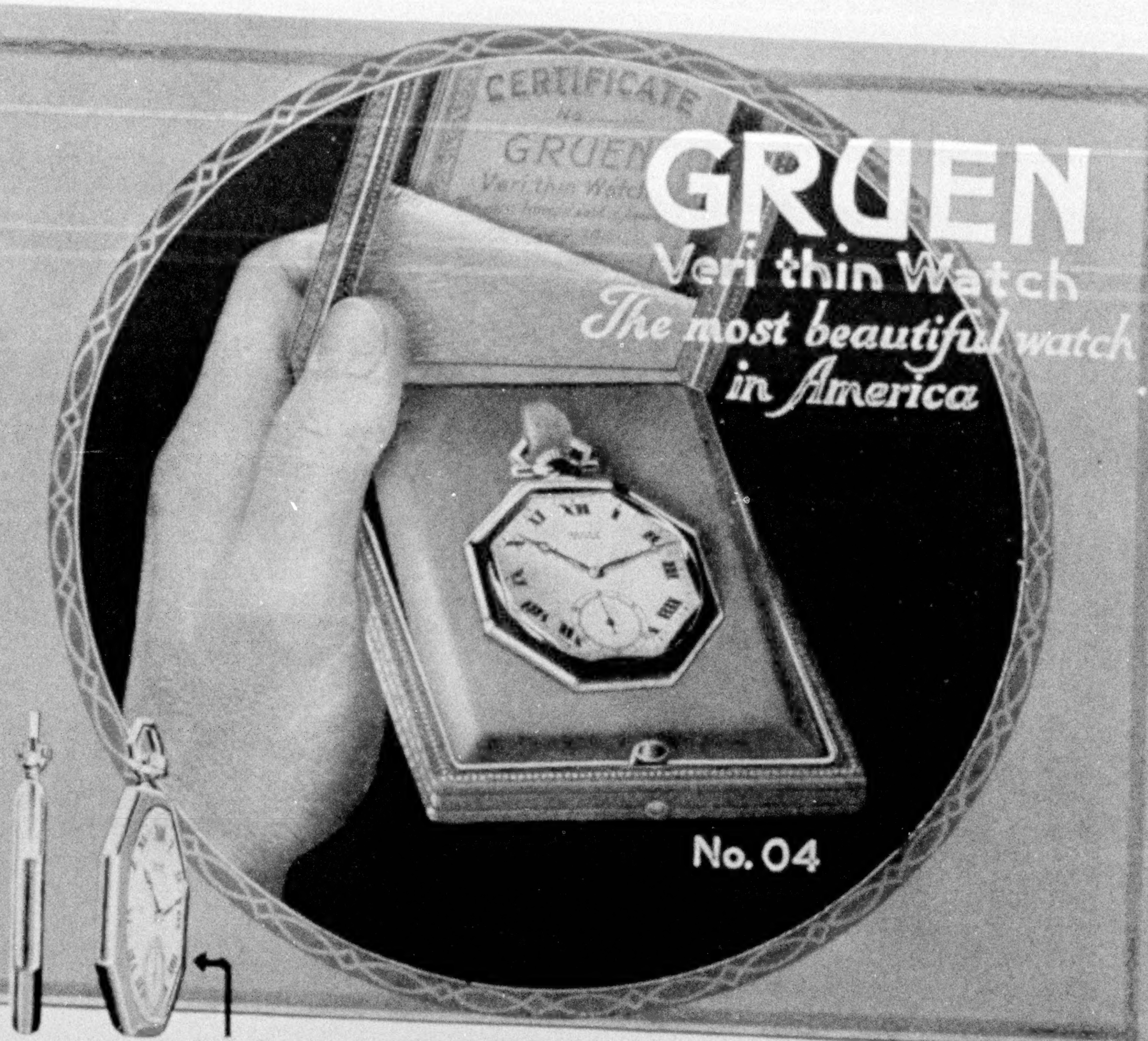

See that second hand is at bottom of dial, as in every Gruen Verithin, which indicates full-size movement. When up towards center, it means thinness is obtained by inserting lady's size movement in man's size case.

Presenting *The new Octathin Model*

an exceptional value at $40.00

Here is a watch of real distinction. To that beautiful thinness for which the Gruen Verithin is famous has been added a new charm in the shape of the case.

No. 04—Ultra (better than 25-year) 14k. gold filled, **$40.**

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The movement is the genuine, original GRUEN VERITHIN, 17-jewel, adjusted to five positions, temperature, and isochronism—the thinnest durable watch made.

GRUEN VERITHIN movements, with the trade-mark PRECISION engraved on the plates, guaranteed to come within Observatory time requirements—in heavy 14k. solid gold Octathin case—priced as follows:

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See the Certificate of Real Value

Under the "Gruen-Special-Service-System" the guarantee certificate in the box is made out in owner's name, with the agency's and maker's signatures attached after the watch is sold.

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Go see the Gruen Octathin at the leading jewelers in your city. If they are out of it, write us, specifying the model in which you are particularly interested and mentioning your jeweler's name, and we will arrange for you to see it.

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THE GRUEN WATCH MFG. CO.
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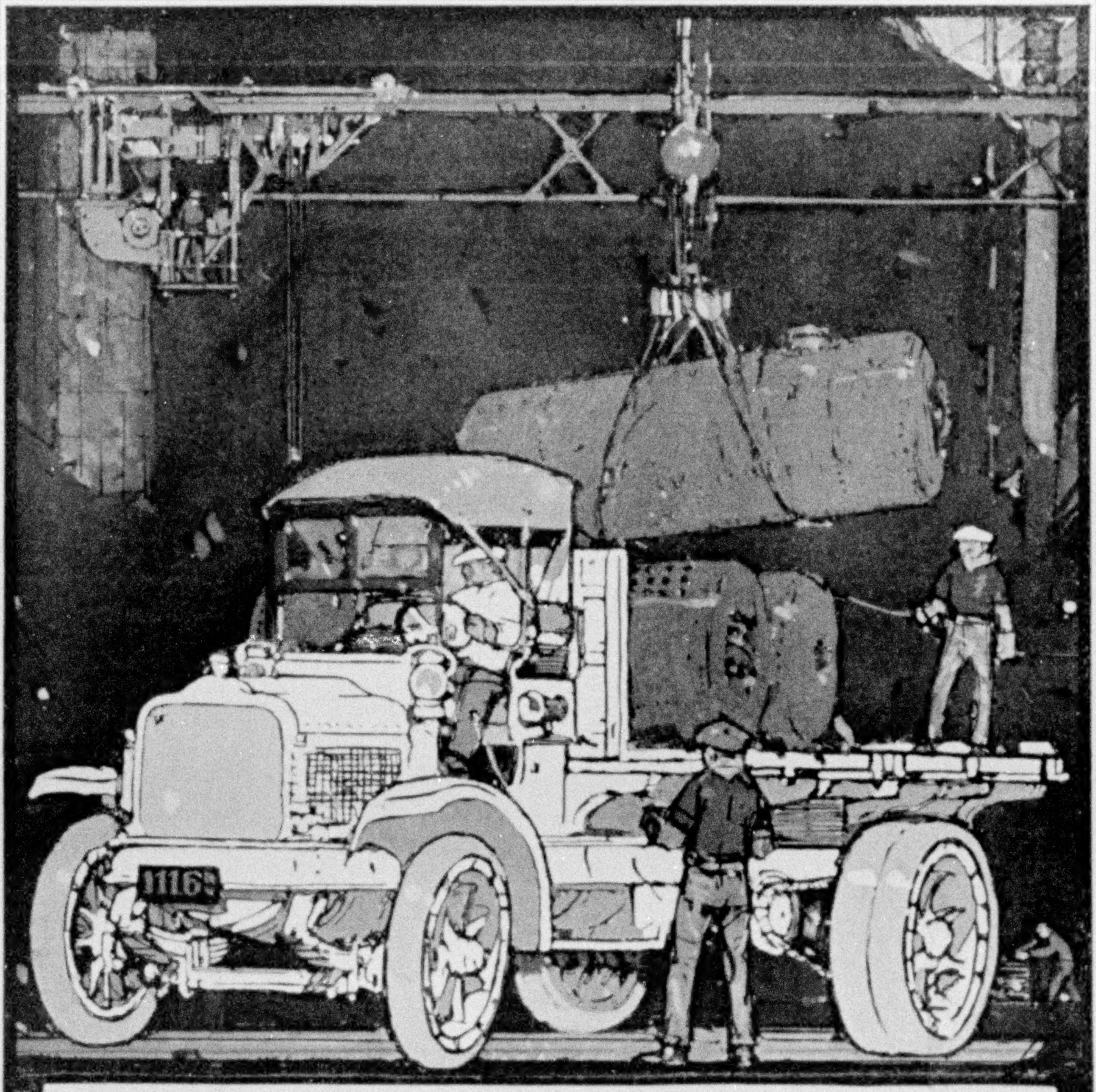
Factories: Cincinnati and Madre-Biel, Switzerland.
Canadian Branch: Toronto, Ontario.

GRUEN WRISTLET WATCH



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When the annual sales of a higher priced truck like the White exceed those of *any grade* competitor two to one, it must have unusual value to its owner. There is no sentiment about buying trucks. Low eventual cost is the only criterion of value.

The White is the dominant truck of America, judged both by the number annually put into service and by their aggregate value.

ONLY GRAND PRIZE for Motor Trucks, Panama-Pacific International Exposition, San Francisco

THE WHITE COMPANY
CLEVELAND
Largest Manufacturers of Commercial Motor Vehicles in America

1917

The

LOCOMOBILE COMPANY

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ANNOUNCES:

A series of Six Cylinder Cars, fashionably low in appearance, quickly responsive to power demands, sweet-running, and restful.

Locomobile Coach Work equips the perfected Chassis with a beautiful body, individual in detail, and finish, and of any desired style.

These luxurious cars are expensive, but having the finest materials and workmanship, are undeniably superior, and being produced in small quantities, are exclusive.

The BOOK OF THE LOCOMOBILE
is available to those interested in fine cars.

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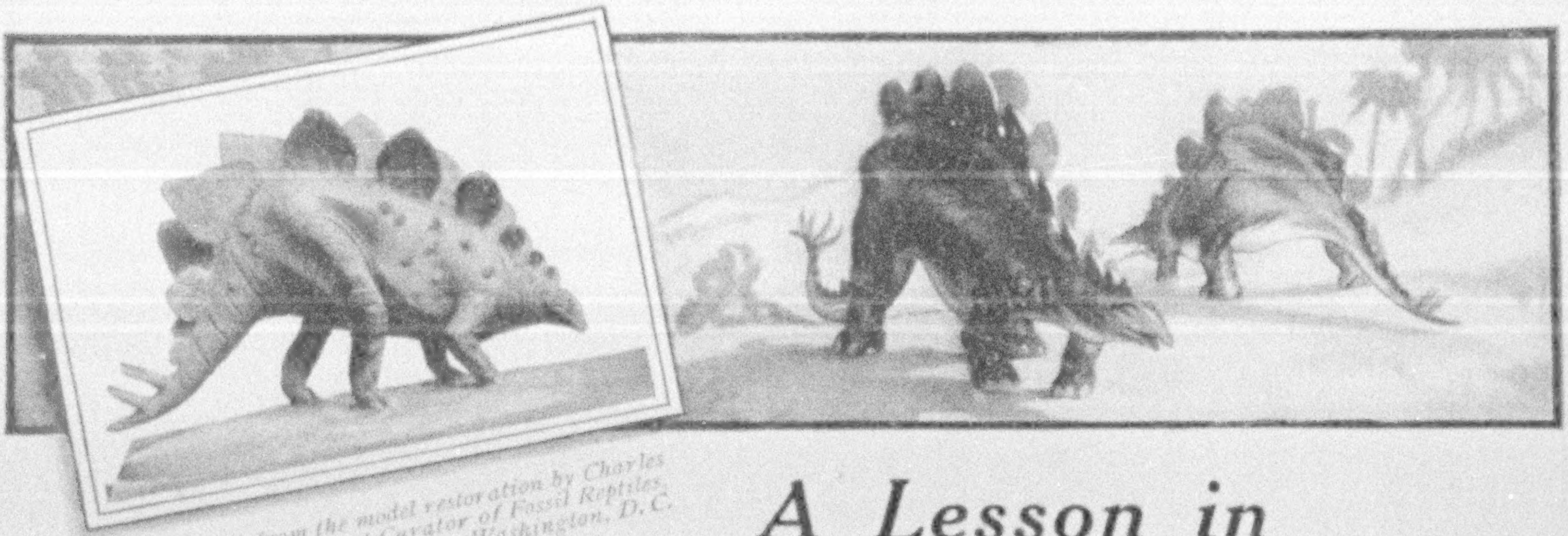


Reproduced from the model restoration by Charles W. Gilmore, Assistant Curator of Fossil Reptiles, in the U.S. National Museum, Washington, D.C.

A Lesson in Preparedness

Stegosaurus—the plated lizard—whom you see above, has a fine lesson in preparedness for us today, though he died some eight million years ago.

He did not care for his teeth and all his 15 feet of spiny length and his armored hide did not save him. His teeth gradually weakened from eating ferns and toadstools instead of the tougher branches he formerly fed on, which helped to cleanse his teeth as he chewed.

In the course of time he became what we call a weakling, and then, like all weaklings, he could not fight the battle of life. He was overwhelmed by stronger reptiles and by his own weakness, and finally every Stegosaurus was gone. There are only fossils to show that they ever existed.

This may seem rather fanciful as a reason why you should use Colgate's Ribbon Dental Cream twice every day—but the lesson is there. Your dentist or your doctor will tell you how necessary it is to care for the teeth—and what a superior dentifrice you have in Colgate's.

It cleans the teeth thoroughly and safely and the flavor is so delicious that you enjoy its twice-a-day use.

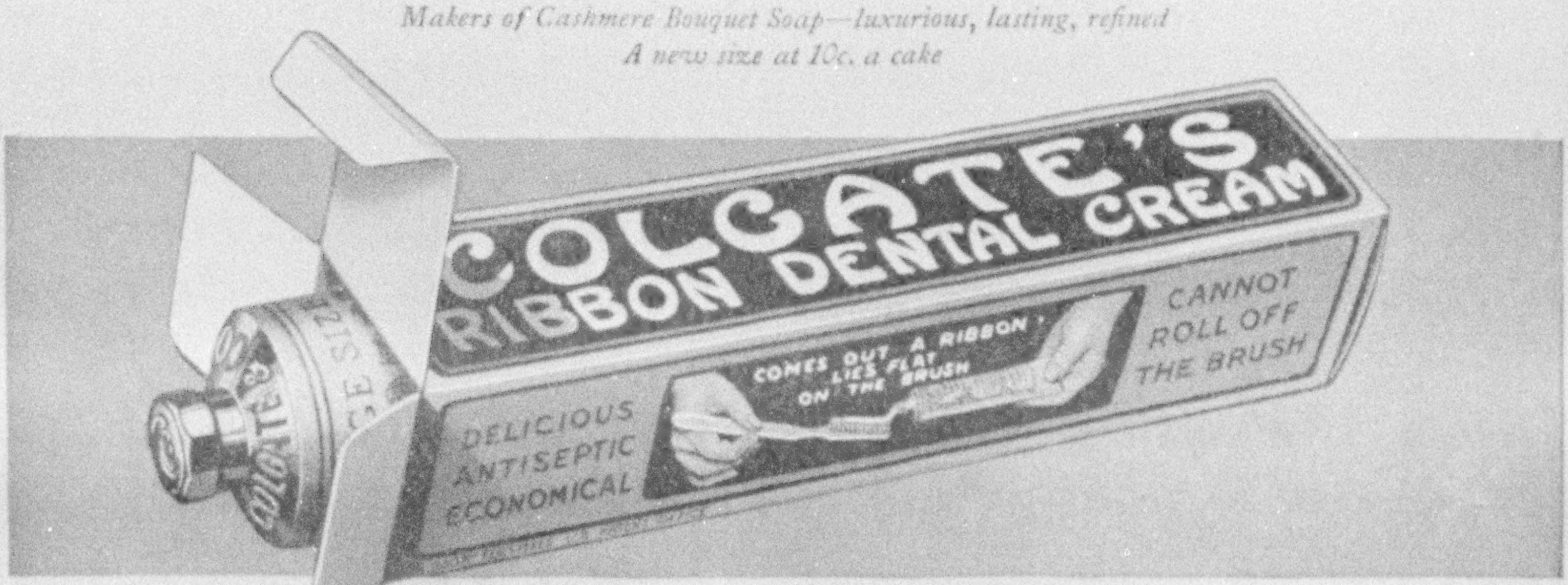
Be prepared—use Ribbon Dental Cream and know

Good Teeth — Good Health

Sold everywhere—or a trial tube sent for 4c. in stamps

Colgate & Co., Dept. 66, 199 Fulton Street, New York

Makers of Cashmere Bouquet Soap—luxurious, lasting, refined
A new size at 10c. a cake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